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The English edition of this work (already published in Russian and in French) has been enlarged and revised by the author. For various additions and references she is indebted to the Editor.

SLEEP.

CHAPTER I.

THE PHYSIOLOGY OF SLEEP.

The love of the Miraculous—Dreams as Suggestions of good or evil Spirits—Comparatively little attention given to the Scientific Study of Sleep—Changes in the Respiration during Sleep—Variations in volume of different parts of the body—The Pulse slackens during Sleep—Dilatation of the Surface Vessels—Contraction of the Vessels of the Brain—Increase of Perspiration during Sleep—Digestion and the Activity of the Internal Organs—State of the Blood during Sleep—State of the Peripheral Nervous System and of the Spinal Cord—State of the Muscular System and the Motor Nerves—Why it is possible to awake at any moment—Determination of the depth of Sleep—State of the Brain during Sleep—State of Will and Attention—Condition of the Pupils and of the Visual Axes—Why we close our Eyes in Sleep—Localising Theories of Sleep—The Vasomotor Theory of Sleep—Chemical Theories of Sleep—Histological Theories of Sleep—Defects of the Chief Theories—Yawning—The Psycho-Physiological Theory of Sleep—Sleep in Children and in Savages—Absence of Sleep in animals deprived of Brain—Caspar Hauser—Sleep in old age—Sleep regarded as a useless or injurious habit—Experiments on prolonged absence of Sleep in Animals—In Man—Sleep is the resting-time of Consciousness.

WE all love life, and we all wish to live as long as possible; yet the third part of our lives, and sometimes even the half, we give up to sleep. "Why try to prolong life if so much of it is to be

spent asleep?" is a question long since asked by Kant, who advised early rising and a decrease of the hours devoted to sleep.

What, then, is sleep? In what respects does a sleeping man differ from a waking man? Such are the questions we shall here have to consider.

It would be difficult to find any aspect of life towards which so much injustice and ingratitude have been shown as towards sleep, for not only do we profit continually by all the benefits of sleep, but even abuse them. Yet we pay no attention to its phenomena, and do not even include it among the questions deserving of serious study. It is sufficient to observe what passes around us every day in order to convince ourselves that while ordinary people, as well as men of science, find the time and the will to study, more or less seriously, abnormal psychic phenomena, such as so-called thought-reading, the alleged somnambulistic transference of visual capacity to the finger-tips and of hearing to the stomach, together with the pseudo-miracles of spiritualism, yet with few exceptions they do not think it necessary to devote themselves to the allied study of sleep and its causes; though, as Macario many years ago remarked, "there is no more interesting subject of study, for it concerns the highest questions of physiology, hygiene, pathology, and psychology."[1]

If we pay no attention to sleep, we thereby admit that a third part of our lives is unworthy of investigation. It is evident that sleep, constituting a considerable and strictly defined part of life, must have an intimate and constant relation to life, so that

[1] Macario, *Du Sommeil*, etc., 1857.

many details of waking life cannot be understood until the phenomena of sleep are explained and understood.

In the following pages we shall frequently have occasion to recognise the truth of this statement, for there are many questions which the insufficient data yet at our command do not enable us to answer.

The fact is that, although the problems of sleep have exercised some of the greatest intellects of ancient and modern times from Aristotle downwards, all that we really know of sleep is due to the labours of a comparatively small number of workers, and it is necessary to warn the reader beforehand that in the course of this investigation we shall often be forced to content ourselves with somewhat barren and incomplete explanations. This is inevitable. We usually grow enthusiastic over the things that shine in the inaccessible distance, everything that is marvellous and improbable. We scarcely remark the marvels that are spread around us and within us, although on a just appreciation of these depends in large part not only our own health, but also the comfort and happiness of others. We do not remark these things, while we give ourselves much trouble and expend much energy in demonstrating the possibility of phenomena in direct opposition to the recognised laws of nature. Thus every one knows with what admirable patience our contemporaries sit in dark rooms in the expectation of mysterious noises and strange events, the raising of tables and chairs, or the materialisation of invisible beings belonging to the world of spirits, with other phenomena of the same order. But although we devote so *much study* to these matters, the pheno-

mena of normal sleep in this nineteenth century are still so little studied that we do not yet know how to modify the conditions of sleep in accordance with different diseases, or the exhaustion of the various organs, or the changes in daily life.

Only from one point of view has sleep notably attracted the attention of men. In dreams men have seen a method of predicting the future; they have cherished the faith that such visions foreshadow events hidden from mortal eyes by the impenetrable veil of futurity. In the most remote times a peculiar and prophetic meaning has been sought in dreams. Throughout classic literature also—in Homer's *Iliad*, in Virgil's *Æneid*, in Ovid's *Metamorphoses*—we find the record of prophetic dreams. It is so also in mediæval literature. These tendencies and attempts have continued with remarkable persistence to our own days, not only among the general population but also among the higher classes. Of this the numerous and often reprinted books on the interpretation of dreams, as well as the attempts we may often hear in conversation to find a prophetic meaning in dreams, furnish sufficient evidence.

It is among facts of this order that we may find the first glimmer of the idea of "suggestion," which has now given rise to a whole literature. In attributing to dreams a prophetic significance, men regard them as the "suggestions" of good or evil spirits. This idea, as it developed, has given rise to a more or less regular system which has, as it were, left deep marks on the neuro-cerebral system of humanity. At the end of this nineteenth century, so proud of its civilisation, this idea of suggestion, transmitted by our ancestors in a latent state, has suddenly revived

and now imposes itself on the attention of men of science. A strange literature has arisen which seeks to show that by suggestion employed in the hypnotic state all diseases may be cured or alleviated, that the lazy may be made diligent, the honest criminal, and the vicious and criminal good and honest. It is a remarkable phenomenon, and deserves serious attention.

In expressing this opinion I have in mind, not the theory of suggestion, but the fact that, owing to the laws of heredity or tradition, the thoughts and beliefs of our ancestors may revive in us and take on new forms better adapted for the conditions of modern life and contemporary science. Facts of this kind recall to mind the saying of Goethe, that each of us really exhibits very little originality, very few qualities that are really personal, for most of our qualities and characteristic traits are but modifications of the qualities and traits of this or that ancestor.[1]

Tylor has shown that the familiar objects of our dwellings, the ordinary ornaments of our furniture and houses, our children's games, preserve the traces of beliefs, customs, and religious rites which once flourished on the earth and have since been forgotten,

[1] "Vom Vater hab' ich die Statur,
Des Lebens ernstes Führen,
Von Mütterchen die Frohnatur
Und Lust zu fabuliren.
Urahnherr war der Schönsten hold,
Das spukt so hin und wieder;
Urahnfrau liebte Schmuck und Gold,
Das zuckt wohl durch die Glieder.
Sind nun die Elemente nicht
Aus dem Complex zu trennen,
Was ist denn an dem ganzen Wicht
Original zu nennen?"

lost in the dust of ages. These beliefs and customs and rites have not really disappeared; they live and surround us in our dwellings, and greet us in our children's games. And just as our material environment preserves traces of these faiths and opinions which once caused men's hearts to beat with hope or joy or sorrow, so our souls preserve traces of the thoughts and emotions which once lived and fermented in the brains of our ancestors. The man of to-day is in a manner the echo of his ancestors, and the vibrations of his soul are often the response to something that vibrated of old in the grey distance of a dozen centuries.

Generations of men live and disappear as the snow disappears, but their qualities and their thoughts, the ideas they elaborated and the thoughts they conquered are not engulfed in the all-engulfing abyss of time. "All that is repeats what was," sings a Russian poet (Ogareff), and we ourselves are but the repetitions of those who preceded us.

"Mais où sont les neiges d'antan?" sadly asked the old French poet. "The snows of yester-year" have disappeared like our ancestors, but they are born anew in the snows of to-day, just as contemporary generations often reflect and renew the beliefs and ideas of our ancestors.

I have remarked that men are only interested in sleep in so far as it satisfies their love of the marvellous and their longing to divine the future. Among us in Russia this tendency is even reflected in the language, so that we employ the word *son* (sleep) also to designate dreams, although to designate these the Russian language possesses another word *(snowidenja)*. It is evident that if we have acquired

the habit of using the word *son*, which designates a general state of the organism, to express a partial phenomenon of that state, it is only because that partial phenomenon is considered the most important and interesting part of the general state.

First of all I will endeavour to state as precisely as possible the differences between the waking and the sleeping states.

It is common to compare sleep and death; we often call Sleep the brother of Death. But however picturesque it may be, this comparison cannot be seriously justified. By death we mean a complete arrest of all the bodily functions, both of the psychic and also of the vegetative life; while during sleep the vegetative functions are not interrupted, and only a few of the psychic functions suspended, the rest continuing to act with more or less modification.

The General Phenomena of Sleep.—When we fall asleep the eyelids are lowered over the eye-balls, which turn upwards, and the voluntary muscles are relaxed, so that the whole body, and especially the face, presents a picture of complete repose. At the same time the respiration is more or less modified; it becomes slower and, according to Mosso's observations, the amount of inspired air is considerably diminished, so that instead of seven litres a sleeping man often inspires only one litre. The respiratory act also changes its character; while during the waking state abdominal respiration usually predominates in man, during sleep thoracic or costal respiration predominates. Sleep produces a weakening of the action of the diaphragm, according to Mosso;[1] at the same time inspiration is more prolonged than

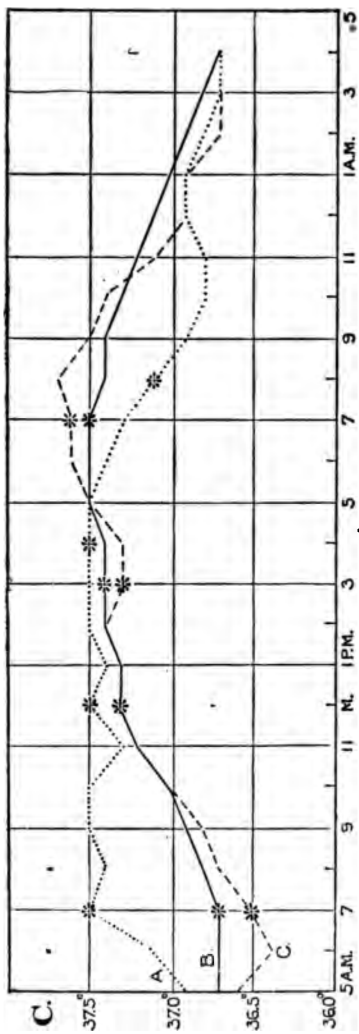
[1] *Archiv. für Physiologie*, 1878.

during the waking state, occupying ten-twelfths of the respiratory period, instead of eight-twelfths. The respiratory pause is absent during sleep, and the depth of respiration considerably diminished.

The foregoing observations apply to men. The changes that take place in the respiration of women, which in the waking condition is usually costal rather than abdominal, have not been observed. The same ignorance prevails in respect to children.

The investigations of Voit and Pettenkoffer from one side,[1] and those of Scharling from the other,[2] have shown that sleep modifies the entire character of the gaseous exchange in the body; there is a decrease in the quantity of carbonic acid eliminated —42 per cent. by night as against 58 per cent. by day, according to Pettenkoffer and Voit—and an increased absorption of oxygen. It must be added that the elimination of carbonic acid depends on other factors besides sleep: the darkness, the absence of muscular exercise, the period at which food was ingested, and the amount taken. Henneberg's experiments on animals (bullocks and sheep) show that under the influence of inanition there is a considerable diminution in the elimination of carbonic acid during the night, while it is increased, especially at night, when the animals receive their ordinary food. Since the investigations of Regnault and Reiset[3] it has also become clear that even the quality of the food influences the gaseous exchange, asleep as well as awake. When animals are given meat, *i.e.* albuminous nourishment, they eliminate 79 per cent. of

[1] *Sitzungsberichte d. königl. bayer. Acad.*, 1866-67.
[2] *Annalen d. Chem. u. Pharm.*, 1843.
[3] *Annales de Chimie et de Physique*, 1863.



Temperature curves by different observers; * indicates a meal (Landois).

the inspired oxygen in the form of carbonic acid; while when fed on starches they eliminate 91 per cent. of the oxygen as carbonic acid. All alcoholic drinks, tea, and the ethereal oils considerably diminish the elimination of carbonic acid, and so far as can yet be judged, all these liquids increase the absorption of oxygen (Proust, Vierordt). Speck's experiments, also, have shown that the elimination of carbonic acid is intimately related to the ingestion of food.

In any case we may conclude—and Boussingault's observations on turtle-doves confirm that conclusion—that during sleep the gaseous exchange in our bodies is diminished.

Thus we see that sleep modifies the mechanism of respiration, rendering it more costal in men, while at the same time the inspirations are lengthened, the amount of inspired oxygen increased, and of eliminated carbonic acid decreased. But that is not all. Cardiac action is modified at the same time as respiration; the heart works more slowly and less energetically than during the waking condition. This difference is marked even at the beginning of life. Bouchart found that a child of from twenty-one days to six months has a pulse of 140 awake, 121 asleep; and from that age onward to the twenty-first month, of 128 awake and 112 asleep. At the same time the peripheral vessels dilate, the blood pressure falls, and there is also a certain decrease of the internal temperature, which may fall in winter as low as 36.05° C. and in summer to 36.45°.[1] The minimum

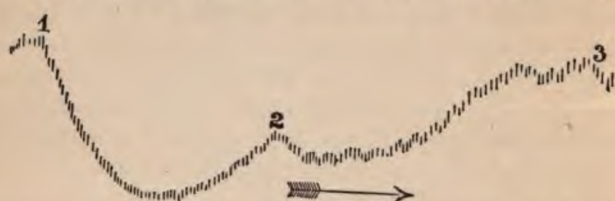
[1] Mosso's experiments on the human subject show that this diminution applies to the brain also, but that there is no perceptible connection between a fall of temperature and the act of falling asleep. He has *also noted* sudden rises of temperature which he calls organic confla-

temperature is observed between midnight and three o'clock in the morning, or, according to some observers, between four and seven o'clock. The dilatation of the surface vessels appears earlier; they swell in the evening, and thus it is that in the evening we find that our collars and other close-fitting parts of our garments become tight and uncomfortable. Martin measured the volume of different parts of the body, awake and asleep, and found that during quiet sleep at night the chest became eight lines narrower, while after a sleepless night the chest had enlarged ten lines and the belly five. These observations were made in the last century, but they are confirmed by the contemporary investigations which demonstrate the decreased gaseous exchange and the modification of the respiratory mechanism during sleep.

But in thus analysing sleep, we must not forget that it is not a permanent and invariable state but presents certain modifications, according to the period it has lasted, the time of night, the character of the dreams, the state of the organism, whether or not any supper has been taken, etc. Thus the pulse slackens during sleep—a fact already known to Galen—but this slackening is not constant and uniform; it always presents certain variations. In a man whose pulse was 70 between six and eight o'clock in the evening, it was only 54 during sleep at midnight; after midnight it began to quicken, and this acceleration lasted till two in the morning; then it slackened again to accelerate once more at five or six o'clock. In the

grations, and which may be produced by noises or other external stimuli but do not appear to be connected with vivid dreams, or at all events remembered dreams. (Mosso, "Osservazioni sulla temperatura del cervello dell' uomo," *Atti dell' XI. Congresso Medico Roma*, vol. ii.)

same way certain variations have been observed in the volume of the thorax, and also of the hands, feet, and abdomen; after two hours' sleep the volume of the thorax was $\frac{2}{35}$th less than in the waking state; after four hours' sleep the decrease was $\frac{3}{35}$th, but only $\frac{1}{35}$th after six hours, the chest having again enlarged. The volume of the hand had diminished after two hours' sleep by $\frac{2}{36}$th and after four hours by $\frac{3}{36}$th, while after six hours the diminution was only $\frac{1}{36}$th. The volume of the abdomen and feet after six hours' sleep



Plethysmographic record taken from the arm of a person sleeping in the laboratory. A fall in the curve indicates a decrease in the volume of the arm. The curve is to be read in the direction of the arrow. 1, the night-watchman entering the laboratory, waking the subject, who shortly fell asleep again; 2, the watchman spoke; 3, the watchman went out; these changes (2 and 3) occurred without awakening the subject. (From experiments made by Messrs. Bardeen and Nichols, John Hopkins Medical School.)

was the same as when awake, but was diminished after four hours. These variations during sleep have not yet been sufficiently studied, but they need to be taken into account.

Mosso's plethysmographic experiments have, however, demonstrated the enlargement of the limbs during sleep, and more recently, Professor Howell of the John Hopkins University has studied the circulation during sleep by carrying on a series of experiments to determine the variations in volume of the

arm, as measured by a water plethysmograph.[1] A small plethysmograph was used, measuring the volume changes only in the hand and lower part of the fore-arm, and allowing comfortable freedom of movement at the elbow; it was thus possible to carry on observation during the whole period of normal sleep. Some twenty experiments were made, though all were not entirely successful. It was found that from the moment when the subject closed his eyes and attempted to go to sleep the curve began to fall, that is, that the portions of the arm within the

Records similar to that in figure on p. 12. Change in the volume of the arm of the sleeping subject caused by the sound of a music-box which was started at *. (Sleeper not awakened.)

plethysmograph undergo dilatation. As sleep comes on, the curve continues to sink with fair regularity, falling to its lowest point in one to one and a half hours, when the dilatation of the arm reaches practically its maximum extent, remaining at this level for an hour or two with certain rhythmical variations. Then the curve shows a steady rise, quite gradual for the first hour or more, but much more rapid for the half-hour or so preceding final conscious awaking. These changes in volume are interpreted by Professor

[1] W. H. Howell, "A Contribution to the Physiology of Sleep, based upon Plethysmographic Experiments," *Journal of Experimental Medicine*, vol. ii., No. 3, 1897.

Howell as meaning a vaso-dilatation in the arm-vessels, due mainly to a relaxation of tone in the skin vessels, which, there is every reason to believe, occurs over the cutaneous surface generally. Consequently there is a general fall of arterial pressure.[1] Taking these facts together, Howell regards it as highly probable that during sleep there is a diminished peripheral resistance in the skin area, and therefore a lower arterial pressure, and a smaller blood-flow through the brain. During the period preparatory to sleep the blood-flow through the brain begins to diminish in quantity owing to the fall in arterial pressure, and grows less for an hour or more after sleep has appeared. After reaching its minimum the brain circulation remains, with temporary variations, practically constant for one or two hours, perhaps longer; then the blood flowing through the brain begins to increase gradually, following the rise in blood pressure produced by the slow constriction of the skin vessels, and becomes more rapid just before spontaneous awakening, when it is approximately the same as when sleep appeared.

Thus, while the surface vessels of the body enlarge more or less during sleep, the vessels of the brain contract and its volume diminishes. Observations have been effected regarding this point both on men and on animals, and these observations have been further verified by the examination of subjects whose brains had been uncovered by injury to the head. All these investigations have shown that the brain grows pale and contracts while the subject is asleep, and on the

[1] Tarchanoff (*Arch. ital. de Biologie*, 1894, p. 318) found that in young dogs the fall of general arterial pressure on falling asleep amounted to from 20 to 50 mm. of mercury.

contrary takes on a rosy hue and rises in the wound at the moment of awaking. The depression of the brain at the moment when the subject falls asleep has been observed by Krauss, who found it equal to a millimetre. Mosso has lately utilised such patients to follow by the graphic method the variations which take place in the volume of the brain during sleep. He found that while it diminished during sleep, every sudden noise or light disturbed repose and caused an increase of volume without awaking the sleeper. Mosso's balance beautifully shows the connection between sleep and anæmia of the brain. If the subject, when horizontally poised on this balance, falls asleep, the feet begin to fall, showing the blood has left the head, and the inclination appears to be proportional to the depth of sleep.

Professor Patrizi, of Tassari, has also shown by experiments with the plethysmograph on two boys, one of whom had a large opening in the cranial vault, that the time occupied by the vasomotor reflexes is instructive from this point of view. When various stimuli—tactile, electric, thermal, etc.—are applied to different regions in the waking state, it is found that vasomotor reflexes follow at almost the same time, whether the stimulus is applied to, for instance, the leg or the arm, with a slight advantage in the latter case. During sleep there is marked retardation in the vessels of the brain, considerable retardation for the arm, while the abdominal reflexes remain constant, so that there seems to be a progressive diminution in the depth of sleep as we proceed from the brain downwards.[1]

[1] M. L. Patrizi, "Il tempo dei riflessi vasali del cervello e delle membra nella veglia e nel sonno," *Dritter internat. Cong. f. Psych.*, München, 1897, p. 422.

Recently, also, the studies of Dr. Leonard Hill have shown a constant relationship between arterial anæmia (with venous congestion) and sleep; and he points out that to court sleep is to avoid all the excitations from the external world which would arouse the vasomotor centre. "The vasomotor centre is the hub around which turns the wheel of a man's active mental life."[1]

Similar results have been obtained by experiments on animals (usually dogs) from which a fragment of the bone of the skull has been removed by trepanation and replaced by a watch-glass (Hammond, Durham).[2] These experiments have shown positively that during a more or less normal and quiet sleep the brains of animals become more or less pale, and at the same time diminish in volume. They become paler if the animals have eaten before sleeping. Vizioli has reached the same conclusions. He has also studied the state of the spinal cord during sleep, and has found that its vessels also present a certain contraction at this time. Having also observed the blood pressure in the carotids during sleep, he has found that it always diminishes.

After considering the state of the respiration, temperature, heart, brain, and spinal cord in the sleeping man, we are now naturally brought to consider the

[1] Leonard Hill, *The Cerebral Circulation*, London, 1896.

[2] W. A. Hammond's experiments, which were earlier, are detailed in his memoir on "Sleep and Insomnia," *New York Medical Journal*, May 1865; *Sleep and its Derangements*, 1869; and *Treatise on Insanity*, sec. iii., 1883. Durham's careful investigations are recorded in "The Physiology of Sleep," *Guy's Hospital Reports*, 1860, p. 149. But the earliest demonstration of the anæmia of the brain during sleep seems to have been furnished by Donders, who in 1854 trepanned the skull of a dog, inserting a piece of glass in place of the fragment of bone removed.

state of the other organs of the body during sleep.

The sweat-glands of the skin act more or less energetically during sleep, a fact which may be explained in part by the dilatation of the vessels of the skin, and in part by the influence of the sweat centre, which is situated in the middle of the medulla (Adamkewietch, Marmé, Navrotzky), and is irritated by the carbonic acid. The observations of Santorini and Becker have shown that the skin acts more energetically at night and during sleep, and that this in part explains why the atmosphere of our bedrooms becomes impure more rapidly than that of the rooms in which we carry on the occupations of our waking life. It must not be forgotten that the skin eliminates at least twice as much vapour as the lungs. It is in consequence of this active perspiration that during sleep we are more liable to chills than when awake.

The internal organs during sleep are in a condition of more or less pronounced anæmia, for the very reason that the skin is in a state of hyperæmia, or gorged with blood. Busch's observations on a patient with fistula of the stomach demonstrated that the movements of the stomach and intestines were interrupted or more or less enfeebled during nocturnal sleep, while on the contrary they went on uninterruptedly if the patient slept in the course of the day.[1] The same phenomenon of enfeeblement or temporary arrest is observed in the functions of the other secreting organs—the kidneys, salivary glands, etc.—but this does not mean that these organs are necessarily in a state of inactivity during sleep. On the contrary, sleep is not modified when the stomach and intestines

[1] Virchow's *Archiv.*, 1858, Bd. xiv.

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continue in full activity, as we may easily convince ourselves by observing little children, who after eating peacefully fall asleep. Among us in Russia the peasant likes to eat when the daily work is over and to go to bed immediately afterwards. In many cases, indeed, we shall find that a meal taken immediately before going to bed may even be beneficial. Facts of this order show that the digestive organs may continue in full activity during sleep. Busch's patient, also, digested perfectly when she slept in the course of the day. Observations and experiments on animals prove that food taken before going to sleep is assimilated very well during sleep, much better than if the animal is forced to walk or run after feeding.

In the same way the kidneys may secrete as actively during sleep as in the waking condition (Durham); sometimes they can act more energetically during sleep; thus Becker and Penzoldt, as well as Fleischer, have shown by direct experiment that more urine is sometimes secreted during the night than during the day. Mendel found that more phosphoric acid is secreted by night than by day (though this is not in accord with the results of Beaunis), and Marro also found that during sleep there is greater elimination of phosphoric acid and especially of the earthy phosphates, while often, on the other hand, a greater elimination of the alkaline phosphates accompanies mental activity, but he admits that the amount of phosphoric acid is influenced by many causes.[1] According to Bouchard, the urine during sleep is more poisonous in its effects on animals than that of the waking, the former being a convulsant, while the latter only produces narcotic effects. The

[1] A. Marro, *Lavoro Mentale e Ricambio Materiale*, Turin, 1889.

general tendency is, however, for the functions of the kidneys to be less active during sleep on account of the greater activity of the skin. Vogel found that less urea is excreted at night—42 gramm. during the 12 hours of day against 36 at night. Beigel's observations, further, show that there are, as indeed might be expected, fewer variations and irregularities in the excretion of urine during the night, and that, for instance, the amount excreted by the two sexes is more nearly equal than during the day.

On the whole we may consider it as certain that it is possible for all the organs of the body to be active during sleep, with the exception of the nervous system, and even this exception is not constant, as we shall shortly see. The opinion that sleep always causes an enfeeblement or arrest of organic activity is chiefly founded on observations on hibernating animals; hibernation cannot, however, be considered a form of normal sleep.

We have seen that respiration is lowered during sleep, and as this exchange is effected by the mediation of the blood and its red corpuscular elements, it is natural to ask what then takes place in the blood. Unfortunately we still lack the precise scientific facts which would enable us to answer this question positively; but we may find some indirect information in the observations which have been made, on the one hand, on persons who pass sleepless nights, and on animals deprived of sleep; and on the other hand, on animals in a state of hibernation. Thus, for example, Keyes found that the number of red corpuscles in the blood showed a considerable diminution after several sleepless

nights passed at the bedside of persons who were seriously ill.[1] On the other hand, Byford has found that every sleepless night accelerates the circulation of the blood, a fact which he thus explains: under the influence of partial or total lack of sleep, the blood undergoes certain changes, losing in part its capacity to fix oxygen and thus becomes impoverished, as regards its red corpuscles, and insufficient to maintain the gaseous exchange to the degree which the activity of all the organs and tissues renders necessary; thus the circulation becomes more rapid, because its rapidity can in some degree compensate its poverty in red corpuscles, of which the function is to distribute oxygen throughout the body.[2]

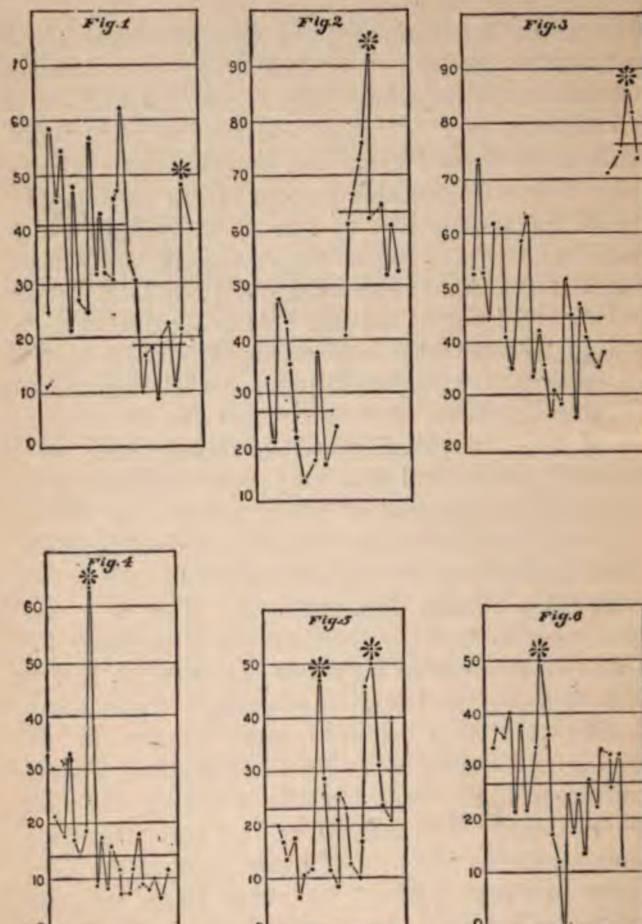
With regard to animals, I have myself found that in puppies experimentally deprived of sleep there is a pronounced diminution in the number of the red corpuscles. Valentin believed that after prolonged hibernation there are no longer any traces of the white blood corpuscles, but this may depend, as we shall see later, on the immobility of hibernating animals. In any case, however, we must finally conclude that we still know little that is definite concerning the state of the blood during sleep.

The Nervous System during Sleep.—What takes place in the central and peripheral nervous system during sleep? Certainly, we all know that when they wish to go to sleep animals as well as men always seek a quiet corner, sheltered from every disturbing noise, every bright light, etc., in a word

[1] Keyes, "The Effect of Small Doses of Mercury in Modifying the Number of the Red Corpuscles in Syphilis," *Am. Journal of the Med. Sciences*, 1876, No. 141.

[2] Byford, *Am. Journal of the Med. Sciences*, April 1856.

from all the impressions of the external world which manifest themselves to us subjectively as a series of sensations. Thus, when going to sleep, we all lower our eyelids over our eyes and seek a comfortable position which will avoid the necessity for any muscular effort. In the arrangement of our beds may be traced the same desire to remove everything which would make too strong an impression on our senses. Facts of this kind show that our peripheral nerves and sensorial organs are still able to act during sleep, and to transmit the impressions which the central nervous system transforms into conscious sensations. We thus reach the conclusion that the whole peripheral nervous system preserves during sleep some power of action, and that to prevent and arrest its activity at the moment of falling asleep, and during sleep itself, we are forced to employ artificial methods, that is to say to avoid and prevent all irritations and impressions coming from without. This is a conclusion drawn from the observation of ordinary life. If we turn to scientific literature, we seem at first to meet very contradictory conclusions: some assure us that sensibility becomes more intense in the evening and during sleep (Moreau, Nathan, Fodéré, Macario, etc.); others, on the contrary, maintain that sensibility is deadened at this time (Burdach, Lemoine, Lotze, etc.). But if we analyse the illustrations brought forward by either party we shall find that all those who speak of the deadening of sensibility during sleep have investigated, not sensibility itself, but conscious sensation, for example, sensations of pain, while the others have examined reflex acts. We must not, however, identify the functional capacity of the nervous apparatus with the



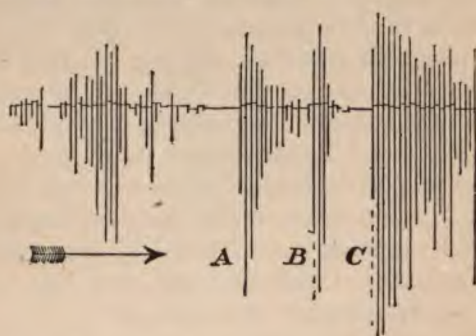
In all these figures * shows a reinforcement of the knee-jerk by some cause or another. In Fig. 1 the subject fell asleep where the curve is lowest, and * shows the point at which he was called. The other figures show reinforcements occurring during the waking state, and due in Fig. 2 to repetition of a poem; Fig. 3, to talking; Fig. 4, itching of the ears; Fig. 5, the crying of a child; Fig. 6, the act of swallowing.

activity of consciousness, for consciousness can be interrupted without arresting the functions of the nerves of touch, the temperature nerves, and other sensory nerves.

It is of some interest to consider the functional aptitudes of the nervous apparatus during sleep. In this connection reference may be made to the influence of sleep on the knee-jerk—that is to say, the involuntary kick given by the leg, hanging loosely, when the knee is smartly struck. The various influences which affect the knee-jerk were carefully investigated by Lombard some years ago.[1] Sternberg had previously found that an extreme condition of general exhaustion, whether produced by physical or mental causes, is accompanied by increase of the tendon reflexes. Lombard found that this was not true of slighter degrees of fatigue, nor was it true of sleep. Cerebral inactivity and sleep alike exerted a depressing effect on the knee-jerk. It is evident that the amount of the knee-jerk is largely dependent on the activity of the cerebral centres, and this is further illustrated by Lombard's repeated observation that a dream of active movement would be associated with a very violent knee-jerk, showing that even during sleep a certain amount of cerebral activity is making itself felt throughout the body. During quiet sleep, and in the absence of other sources of stimulation, external or internal, the knee-jerk may entirely disappear, as is shown in the following graphic record (p. 24) of the knee-jerk in a demented patient, furnished by Dr. Noyes. The knee

[1] W. P. Lombard, "The Variations of the Normal Knee-jerk, and their Relation to the Activity of the Central Nervous System," *Am. Journ. Psychology*, vol. i., No. 1, 1887.

was tapped at regular intervals of five seconds. When the patient was asleep and all was quiet, no response was obtained. After such a period the sound of some one walking on the floor below caused at A a series of kicks, slowly diminishing, and renewed by the same cause at B. At C two taps



with a pencil and a distant locomotive whistle produced a larger series.

Other movements of more or less reflex character have also been investigated during sleep. Thus Rosenbach[1] has systematically observed the reflexes excited in children by tickling the palm of hand, the sole of foot, and occasionally other parts of the body; also the cremasteric, abdominal and tendon reflexes, and the pupil reaction. At bedtime, and when sleepy, reflex excitability increases, a stage of restlessness comparable to the convulsive stage of chloroform narcosis. During the first period of sleep, and while it is still light, there is weakening of reflexes and commencing contraction of pupil; in the second, or

[1] O. Rosenbach, *Zeitschrift f. klinische Med.*, 1881, Bd. i., Heft 2, *and summarised by* Waller in *Brain*, 1882, p. 138.

deeper period, abdominal, cremasteric, and tendon reflexes are abolished; in deepest sleep, tickling the sole of foot, the nose, or ear still causes reflex movement. Rosenbach considers that the active contraction of the sphincters during sleep is due to direct cerebral activity protecting the outlets; because if sleep was only a cerebral paralysis we should get increased spinal reflexes as in decapitated animals, instead of finding that as sleep deepens the reflexes weaken.

An experimental investigation by Professor Tarchanoff is specially interesting from the present point of view. His experiments were made on puppies, which, on account of their age, easily fall asleep, and thus enable us to observe normal sleep. Tarchanoff investigated the state of the cerebral cortex, of the different sensory nerves, and also of the spinal cord during sleep. These experiments showed positively that the brain grows pale when the animals are asleep, that at the same time the cortex ceases to react readily to electrical stimulations which in the waking condition were always strong enough to give well-marked muscular reactions, and that, finally, the spinal cord and the different sensory nerves do not sleep, while sensations of pain are deadened to consciousness. The nerves transmit the painful impressions, but the consciousness of the sleeping animal cannot perceive them, or perceives them but feebly and incompletely.[1]

I may also mention here the observations of Professors Wedensky, Waller, and Bowditch, who have shown that the nerves generally may act during an

[1] Tarchanoff, "Observations sur le Sommeil Normal," *Atti dell' XI. Congresso Medico Internazionale*, vol. ii.

indefinite period, as they do not become fatigued; fatigue is not so much a peripheral as a central change.[1]

I have already noted the fact that every irritation and impression which falls on the body of a sleeping man produces a change in the volume of the brain, and it is easy to understand that this phenomenon would not occur if the sensory nerves were asleep and not in full activity. It must not be forgotten that these changes in the volume of the brain are observed under the influence of the most various irritations—impressions of hearing, luminous and tactile impressions, etc.—so that the sensory nerves in question are ready to fulfil their ordinary functions, that is to say that they can receive irritations or impressions and transmit them to the cerebral centres.

It is thus evident that the various sensory nerves, as well as the spinal cord, are more or less incapable of fatigue and therefore remain awake during sleep.

It still remains to consider the condition of the voluntary muscles. Among various authors who have written on sleep (Despine, Moreau, etc.), we often find the opinion that one of the phenomena of sleep is the complete arrest of all voluntary movement, or, in other words, that the muscular system with its motor nerves sleeps. It is sufficient to observe the

[1] Wedensky (using the telephone to detect negative variation of faradised nerve), *Ctblatt. f. Med. Wiss.*, 1884; Waller (using the galvanometer to avoid fallacy of telephone), "Fatigue and Recovery," *Brit. Med. Jour.*, 1885-86; and finally Bowditch (by the unimpeachable method of curarising the animal), "Note on the Nature of Nerve Force," *Jour. of Physiology*, 1855, and "Nachweis der Unermüdlichkeit des Saugethiernerven," Du Bois-Reymond's *Archiv.*, 1890.

facts of daily life in order to assure ourselves that this opinion is erroneous. We all know, in fact, that a sleeping person changes his position whenever it becomes uncomfortable, and without awaking takes an easier position. In the same way, it is recognised that sleeping persons execute with their hands movements that are altogether rational; for example, they brush away a fly from the face, or draw back the disturbed bed-clothes.

Börner tried the experiment of placing a heavy coverlet over the faces of persons in deep sleep; without awaking, the sleepers always removed the impediment which hindered their free respiration. Occasionally persons arise from bed and empty a distended bladder without awaking. Certain birds always sleep on one leg, and those which sleep on the water in this way, as Headley points out, have a habit of gently paddling with the foot, thus slowly revolving in a circle; so that a group of voluntary muscles continues to act uninterruptedly during sleep. In the old days before railways, postillions and others often slept on the journey. Hammond has frequently seen soldiers asleep on horseback during a night march, and has so slept himself. Infantry often fall asleep during forced marches; in such cases they continue to make all the necessary movements, walk at a regulated pace, hold their guns, etc., without awaking. Cuming knew a punkah-wallah who could work the punkah with his foot fairly well while sound asleep.

The frequency of talking during sleep is a familiar fact, and various observers (Lotze, Bérillon, Moll) have pointed out that some persons will answer questions and obey commands during sleep. This point

was investigated by Speir, Armstrong, and Child.[1] These investigators, among 200 college students of both sexes, between the ages of twenty and thirty, found that 41 per cent. men and 37 per cent. women talk in their sleep. More than half of the women who talked in their sleep, and more than a third of the men, reported that they were able to answer questions when asleep, and the women more often than the men were able to answer questions on any subject, and not merely on that they were talking about. The proportion of those who talk in their sleep is much higher below twenty-five than above that age. Somnambulists, again, while fast asleep execute complicated and often dangerous muscular acts, climbing up steep roofs, and maintaining a delicately poised equilibrium. From the scientific side, also, the observations of Tarchanoff on reflex actions during sleep have directly shown that the motor nerves and voluntary muscles preserve power of activity during sleep.

We thus reach the conclusion that during sleep the brain alone is really asleep. As, however, the brain is constituted of a large number of different centres, which subserve the most various ends, it is natural to ask whether it is the whole brain which sleeps or only a more or less defined portion. After what has just been said of voluntary muscular movements during deep sleep, we are forced to conclude that the centres of the brain by the impulsion of which these voluntary movements are accomplished—as for example, the marching of soldiers while asleep, the muscular labour necessary to hold the gun in a certain position, the walk of a

[1] "Statistics of 'Unconscious Cerebration,'" *Am. Journ. Psych.*, Nov. 1892.

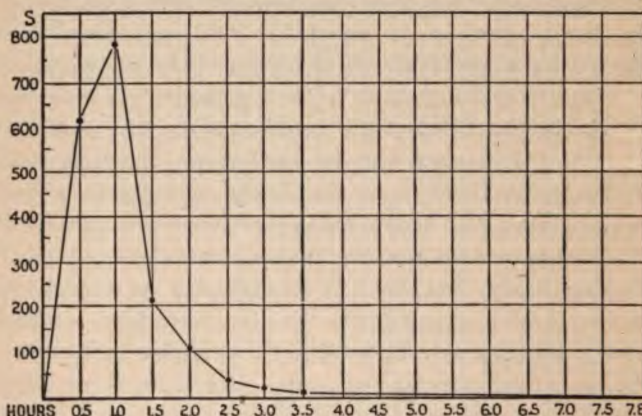
sentry in a certain given direction and extent—could not function unless they were awake at the moment when these movements were executed by the sleepers.

The same thing is shown by Tarchanoff's experiments. He took puppies whose spinal cords he had completely divided above the lumbar region some weeks previously, and which had recovered from the operation. When they were asleep he applied electric stimulation to the hind paws, innervated exclusively by the cut portion of the spinal cord, and found that the reflex movements of the paws were the same as during the waking state. On applying similar stimulation to the front paws, innervated by the anterior part of spinal cord and by the brain, he found that reflex movement was decidedly less than in the waking state and that a stronger current was required. Thus it is evident that the brain is not wholly inactive during sleep, but that it contributes a depressive action which participates in the formation of the reflex movements obtained in the anterior part of the body of the sleeping puppy. We also know that different stimuli applied to hearing, smell, and taste, even luminous impressions also, may cause a whole series of reflex movement in sleep without causing the sleeper to awake, except they are of such energy as to pass over the threshold of consciousness (Herbart, Fechner); then the sleeper awakes with the consciousness that he has been aroused.

We are thus able to state that not only are the optic, auditory, olfactory, and gustatory nerves awake and active during sleep, but also the cerebral centres corresponding to those nerves.

The justice of this conclusion is shown from another side by the evidence of dreams, because if these

nervous centres were asleep and consequently inactive, we should not receive in our dreams representations belonging to the senses of smell, taste, touch, the muscular sense, and common sensation. All the sensations and all the images of dreams are only possible on one condition: that the corresponding centres in the nervous system are in a state of activity, that is to say more or less awake. It is precisely



Curve illustrating strength of auditory stimulus (falling ball) necessary to waken a sleeping person. The hours are marked below, and the tests were made at half-hourly intervals. The curve shows that the height from which the ball must be dropped reaches its maximum at the end of the first hour (Kohlschütter).

because the different nervous channels and the corresponding cerebral centres are awake during sleep that it is possible to arouse a sleeping person at any desired moment.

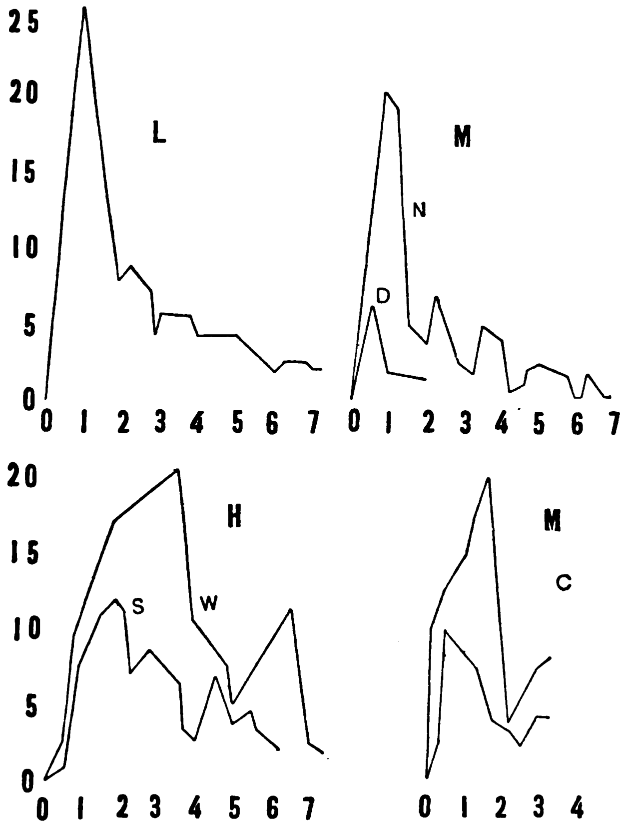
From this point of view Mosso's experiments (recorded in his book on the temperature of the brain), especially those on Delphina Parodi, a young *girl* who in consequence of an accident had lost a

portion of the fronto-parietal region of the skull, are of great interest. This physiologist has observed that any unexpected noise, a touch, in fact any external stimulus which affects the sleeper, at once brings about a change in the volume and temperature of the brain, that is to say that the cerebral vessels receive a considerable afflux of blood under these circumstances, and this temporary cerebral hyperæmia is observed even when the impressions which provoke it are too slight to awake the sleeper or to leave any memory behind. Owing to the fact that the nervous channels and corresponding cerebral centres preserve their activity during sleep, it is possible to measure the depth of sleep; for all the methods employed to this end rest on the supposition that the nerves and centres do not sleep. The principle of all these methods is reduced to the discovery of the intensity of the stimulus needed at different periods of normal sleep to arouse the sleeper, in other words to force the threshold of sleep, which naturally results in awaking the sleeper. It has been found that the best method of measurement is to drop a metallic substance on to a metallic surface from different heights Kohlschütter, Mönninghoff, and Peisbergen have thus measured the depth of normal sleep and have found that it increases during the first and second hour, after which it begins to decrease in a pronounced manner, then it again increases, and after attaining a certain level is more or less maintained at that level. Each awakening produces an increased intensity of sleep, and the same effect is observed even when a pronounced weakening of sleep stops short of complete awakening. Michelson's results were very similar: by measuring the intensity of sleep by the

height at which a brass ball must be dropped to awaken the sleeper, he found that the deepest sleep is reached in about one hour and three-quarters; after that it gradually decreases, with, however, fairly regular rhythmic fluctuations. The experimenter manipulated the apparatus in an adjoining room, and the subject retired to rest unaware that any experiment was to be made. Not more than two experiments were ever made in one night.[1] In view of some slight discrepancies in these results, Professor Howell tested his own curve of sleep intensity, using a new method by which the depth of sleep was measured by the strength of a current from an induction coil necessary to waken the sleeper, the stimulating electrodes (so constructed as to remain moistened with glycerine during the entire period) being placed upon the forehead, and the amount of the induced current measured directly in scale deflections of a dynamometer. It was found that the normal intensity of sleep follows in general the curve described by Kohlschütter, the maximum being reached in the first hour or so; the curve did not, however, approach so nearly to the base line in the second hour and subsequently as in Kohlschütter's curves. These experiments show that the first two or three hours of sleep are the most important, for it is during these hours that sleep reaches its culminating point.

Psychic Phenomena during Sleep.—We thus reach the conclusion that during sleep nothing is asleep within us except the brain, and that even the brain is not wholly asleep but only some of its elements.

[1] Michelson, *Untersuchungen über die Tiefe des Schlafes*, Diss. Dorpat, 1891.



Curves of sleep for three subjects (L., M., H.). N, night sleep; D, day sleep; S, summer sleep; W, winter sleep; C, sleep from narcotics. The numbers on horizontal lines show hours after falling asleep; the numbers on the vertical lines give the energy of the falling ball in thousands of gram centimetres, *i.e.*, the weight of ball multiplied by height of fall (Michelson).

We still have to ascertain what it is that sleeps in the brain. We have seen that the sleeper may be within reach of sensations of hearing, smell, touch, etc., although he is not fully conscious of them and does not awake; but his brain in such cases always increases in volume and the cerebral vessels distend, as has been observed many times, and first by Blumenbach in subjects whose skulls were injured in such a manner as to render visible the pulsation of the brain; it has then been found that during dreams the brain would sometimes rise above the edges of the wound to an even greater extent than during the waking state.

I have already referred to the well-known fact that some people talk during sleep, so that the organs of speech must be in a state compatible with their activity. On the other hand, medical science has sometimes described cases of persons deeply asleep who, on any attempt to awake them, merely said: "Leave me alone," and again fell into the same deep sleep, on awaking from which of their own accord they were unable to recall either their own remarks or the effort to arouse them (Despine). Cleghorn mentions the case of a man in an exhausted condition, who awoke from sleep, took his share of supper with his comrades, sang some songs with them, and went to bed again, without being able to recall any of these events in the morning. Abercrombie narrates a still more interesting case: a lawyer, exhausted by a long sitting of the court, went with his friends to supper at a restaurant; then they talked, drank, bade each other farewell, and dispersed each to his own home, including the lawyer; he went to bed, and on the next day

could recall nothing that had taken place, being convinced that he had gone straight home from the court.

How should we explain cases of this kind? By exhaustion, by the sleep of memory? Yes, but we must distinguish two elements in memory: the memory peculiar to each tissue and cell of the body, and conscious memory. In the cases just brought forward it was precisely conscious memory that was enfeebled, or, in other words, consciousness itself, for conscious memory is nothing more than the persistence of the traces imprinted on our consciousness by sensations, etc.

Some authors[1] have also maintained that during sleep it is our attention and our will (or apperception, as Wundt and his disciples would say) that are asleep, and it is no doubt true that there is no surer means to produce sleep than to fatigue attention. But if this were so we should not be able to awake at a fixed hour, or on hearing a determined sound, however feeble. Many of us have been able to recognise that if on going to sleep we order ourselves, as it were, to awake at such and such an hour, this order is obeyed and we awake at the appointed time. It is a very useful aptitude if, for example, we have to nurse a patient who is seriously ill, for we can awake every hour or every two hours to give the patient medicine, and at the same time obtain the sleep necessary to preserve our own strength. Broussais records the case of a gentleman who possessed this faculty in a very high degree; if he were awakened at any hour of the night and asked

[1] For example, Külpe, *Outlines of Psychology* (tr. by Titchener), London, 1895, p. 451.

the time he would answer the question at once without even glancing at his watch. He was never mistaken in his replies, so that while he slept he must have retained an exact notion of the course of time. It is still more interesting to observe how a mother awakes at the slightest movement of the infant she tenderly loves, although, as Jouffroy, who long since noted this fact, has pointed out, even the loudest tempest may not succeed in arousing her.

This phenomenon has been specially studied in America by Speir, Armstrong, and Child.[1] These observers obtained answers from two hundred college students of both sexes between the ages of twenty and thirty. They found that 59 per cent. possessed the power of waking at a given time without being disturbed before. About two-thirds of these seldom or never fail in their attempt. Only about a third of these are conscious of any special feeling as they awake, and about two-thirds awake directly. A smaller percentage of women (51) than of men (62) possess the power of waking at a given time. With increasing age there are fewer failures in waking at the given hour. The special feeling experienced on waking is usually described as a troubled feeling, "a feeling that I must wake," "that something must be done," etc. One tells how, though a very sound sleeper, he was able to wake up regularly and exactly every two hours for six weeks to administer medicine to his wife, never once missing; "I always came directly from oblivion into consciousness," he wrote; "I was as exact and methodical during the first few nights as at the last."

[1] "Statistics of 'Unconscious Cerebration,'" *American Journal of Psychology*, Nov. 1892.

Facts of this order are only possible on one condition: the sleeper's attention remains concentrated on certain sounds or on a group of determined representations, which supposes an act of will; and it is evident that under such conditions the sleeper's attention and will must preserve their activity during the whole duration of sleep.[1]

The degree of intensity to which our attention may be maintained during sleep is shown by the following case: On going to bed a man recalled that he must rise the next day at eight, at the same time quite forgetting that his clock was half-an-hour fast. In the middle of the night he awoke and on looking at his clock remembered that it was half-an-hour fast, and that consequently he must wake, not when the clock struck eight, but half-an-hour later. He then fell into a sound slumber, which lasted until he felt himself disturbed by some unknown cause. He started up with the dread that he had awakened too late, but looking at his clock, he saw that it pointed exactly to half-past eight. Thus, in spite of deep sleep, the sleeper's

[1] Maudsley, in this connection, recalls that the respiration and pulse beats continue during sleep, sending their measured thrill to the brain, which, when awake, receives them more or less consciously. "Why then wonder that the brain, in whose nature and function time and proportion are ingraft, does that unconsciously, and even makes more delicate time-registers of the finer and more subtile organic processes? Had the brain not that unconscious faculty, the cleverest consciousness might labour in vain to count" (*Pathology of Mind*, 1895, p. 123). It may be added that this power of judging time precisely is sometimes found in the waking state also, though some sub-conscious process seems to be generally involved. In the *American Journal of Psychology* (April 1896) may be found the carefully recorded case of a gentleman (Director of Physical Culture in the University of California) who, at any moment of the day or night, was able to tell the time within three minutes; he considered that he had acquired this power from the habits of his work, which required accuracy in timing.

attention and will not only followed the course of time, but even corrected the error of the clock; the man slept soundly while the clock loudly struck eight and awoke when the hand silently pointed to the half-hour.[1] Will and attention are also equally active in dreams; with this question we shall have to deal later on. I only wish to mention here the well-established fact (Jouffroy) that persons of feeble character cannot awake at a fixed hour. There can be no doubt, however, that force of character is proportional to development of the consciousness. So that we may conclude that consciousness is interrupted while the other functions continue to act with more or less energy during sleep.

In analysing the psychology of dreams we shall see that the most various emotions and passions may act in the sleeping man. In this way we may

[1] The action of will and attention during sleep is also well shown in the treatment of somnambulism adopted by a schoolmaster, as narrated by him to Hack Tuke (Art. "Sleep," *Dict. Psych. Med.*): "Shortly before the youthful somnambulist retires to rest his master calls him aside, and speaking in a firm and solemn tone says, 'I find you were out of bed and making a disturbance in your room last night.' 'Sir,' he replies, 'I was asleep, I know nothing about it.' Then the master replies, 'I will say nothing about it on this occasion, but such a thing must not occur again.' 'But, sir, I could not help it; I was asleep.' 'Well,' the master replies, 'you hear what I say. I would not advise you to let it occur again.'" The schoolmaster added that in such a case the boy goes to bed probably feeling that he has been hardly dealt with, but with a motive for checking the tendency to somnambulism, and the motive continues to act during sleep. This method invariably proved successful.

In such a case we seem to witness the action of suggestion acting inversely to that applied during hypnosis. I may refer to a case recorded by Ringier of a young girl who was told by her companions that she would wet the bed because she had plucked the meadow crowfoot (called *pisse-en-lit* in Switzerland), and who really became subject to nocturnal incontinence of urine in consequence.

explain the diversity of opinion among authors as to the state of the visual axes and of the pupils during sleep, for it is known that the pupils are modified by the emotions, dilating, for instance, under the influence of fear; it would not therefore be surprising to find variations in the pupils, for they might be due to the different feelings and ideas experienced by the sleeping person in dreams. Another source of fallacy is the fact that disturbance of the sleeping person causes a change in the eyes. In falling asleep the axes of the eyes converge and turn upward; this condition is reproduced when we try to raise the eyelid, and hence the common opinion that it represents the usual state of the eyes during sleep (Bell, J. Müller, Rehlmann and Witkowsky, etc.). It seems now, however, to be established that the axes of the eye are parallel, as if directed towards a distant object (Sander), but are sometimes divergent (Lemoine), as they are in profound stupor from cerebral disease, though in ordinary mental stupor they may be convergent (Hack Tuke). With regard to the state of the pupils, I have myself observed in young children that they are dilated, and at the moment of awaking it is certainly the rule for the eyes to be very dilated, even in the presence of strong light. During sound sleep, however, there can now be no doubt that the pupils are contracted, and the deeper the sleep the more they are contracted (J. Müller, Rehlmann and Witkowsky, Sander). This point has been well brought out by the extensive observations of Plotke.[1] Even when the pupil is dilated by atropine it becomes contracted during sleep. The condition of the pupil during sleep thus resembles its condition

[1] *Archiv. für Psychiatrie*, Bd. x., Heft 1.

during hypnosis, as observed by Moll, Sgrosso, and others.

I may also refer here to the discussions which have taken place among various authors as to the real reason why we lower our eyelids at the moment of going to sleep. Bichat tried to show that they are lowered because of the relaxation of the muscles, that there is, so to say, a temporary paralysis. This opinion has been disputed by Stokes, who supposes that the eyes close because the muscles act like sphincters and contract independently of the will. It seems to me simpler and more natural to believe that men and animals voluntarily close the eyes in order to guard the visual apparatus as much as possible from all stimuli coming from without. This precaution is necessary, because the eyes never sleep, and to reduce them to inactivity special artificial measures are required. The probability of this explanation is confirmed by the fact that persons who are seriously ill and almost at the point of death always sleep with the eyes half-open or even quite open. This is due to the fact that the impressionability of the optic nerves and the receptivity of the cerebral centres are becoming dulled. It is easy to understand that such sleep foreshadows the approach of death, and in any case indicates a state of grave danger.

The Theories of Sleep.—Having completed our study of the chief changes which take place in the organism during sleep, we have now to consider the various theories of sleep.

First of all we have theories which assign some localised cause, explaining sleep by the action of this or that organ or tissue. Thus, for example,

some authors have regarded the thyroid gland as the organ of sleep (Forneris), and they expressed the opinion that every night the neck enlarges from the swelling of this gland, due to the accumulation of blood which comes from the brain, this stasis of blood in the thyroid gland being the direct cause of sleep. The theory is erroneous, and is sufficiently disproved by the fact that persons from whom this gland is removed are not liable to suffer from insomnia (Kocher); indeed it has been observed that persons deprived of the thyroid gland have, on the contrary, a special tendency to sleep, and are subject to constant sleepiness. The same phenomenon has been observed in those who suffer from atrophy of the gland.

Another theory of the local order places the organ of sleep in the arachnoid plexus, which works during sleep, filling the ventricles of the brain and thus interrupting all communication between the brain and the body generally. To prove the truth of this theory, its author (Osborne) described three cases of obstinate insomnia. At the autopsies of these patients he found the plexus in a very changed condition and full of vesicles. It is only necessary to remark that this theory is contradicted by all the observations which demonstrate that sleep is always accompanied by cerebral anæmia.

Among the number of local theories of sleep must also be counted that set forth by Purkinje. He supposed that the ganglia at the base of the brain, by reason of an unusual afflux of blood, compress the bundles of the *corona radiata*, and thus interrupt the communication of the brain with the external world. Exner, in arguing against this theory, rightly remarks

that if it were correct, our consciousness would remain unchanged during sleep, which is, however, by no means the case.

The vasomotor theory of sleep has enjoyed a far wider currency. It has found a solid basis on the work of Durham, Hammond, Vizioli, Tarchanoff, and other observers. These investigators have proved that the brain is anæmic during sleep, bringing forward arguments against the belief previously accepted, according to which sleep is only possible when the brain is in a state of venous stasis (Cappie, Langlet, Blumröder, etc.). The theory that sleep is a condition of cerebral congestion is a very ancient one, and during the past hundred years it has received the support of Cabanis, Marshall Hall, Macnish, W. B. Carpenter, G. H. Lewes, Holland, and Sieveking, among others. It no doubt originated, as Hammond has pointed out, in a false analogy between sleep and comatose states in which there is really a condition of cerebral congestion. Blumenbach, in a case of injury to the skull, was probably the first to ascertain by actual observation that the condition is one of anæmia. Durham, in his careful and conclusive experiments, trephined the skull of a dog in the region of the sinciput and replaced the bone by a watch-glass which protected the brain from the influence of the air, and through which he was able to study all the changes that took place in the brain. Unfortunately Durham, as well as Mosso and the other observers who have followed him in the same path, usually made their experiments on animals which had been put under the influence of chloroform, morphia, or chloral hydrate. It must be added, however, both as regards Durham and Hammond, that they waited

until the narcosis was over and the animal had been fed, when normal sleep set in. If there was any doubt it has been dissipated by Tarchanoff. His experiments were carried out on young puppies, who sleep quickly and easily, so that the observer has no need to resort to artificial methods of putting them to sleep, but is able to examine the changes in the brain during sleep that is entirely normal and natural.

Durham showed that during sleep the brain becomes anæmic. By tying a ligature to the jugular veins he was also able to observe the results of venous stasis in the brain, and convinced himself that under such circumstances the brain is in a condition entirely unlike that of normal sleep. It also occurred to him to produce artificial anæmia of the brain by ligaturing the carotid arteries, and he thus obtained a condition of the brain similar to that which he had obtained during sleep. Fleming tried on himself and his friends the experiment of compressing the carotid arteries in the neck for thirty seconds, and always succeeded in producing immediate and deep sleep; "a soft humming in the ears is heard; a sense of tingling steals over the body, and in a few seconds complete unconsciousness and insensibility supervene, and continue so long as the pressure is maintained." The result is not attained unless the pressure is strong enough to cause all pulsation of the carotids to disappear. He also attempted to compress the jugular veins as well as the arteries, and then the subject's face became red and he only fell asleep slowly and with difficulty, nor was the sleep deep.[1] Corning instances the case of a man with acute mania of a violent and protracted

[1] *Brit. and For. Medico-Chirurgical Review*, April 1855.

character; when an instrument devised by Corning was applied to the carotids the man's cries and struggles ceased in a few moments, and he was led to bed, where he at once fell into a peaceful sleep.[1] Again, as various observers have pointed out, the scalp covering the anterior fontanelle in young infants is depressed during sleep and elevated during wakefulness. All these facts prove the intimate association between sleep and cerebral anæmia.

That cerebral anæmia is one of the factors—not necessarily the only factor—in the causation of sleep (instead of being, as some have argued, merely the result of sleep) is indicated by the fact that it precedes sleep. Thus by means of a special manometer, devised independently by Weir Mitchell and by Hammond,[2] the state of the brain as regards its blood contents can be accurately determined by ascertaining the degree of pressure exerted upon the fluid in the tube of the apparatus. A number of experiments with this instrument showed that the fall of the fluid, indicating a lessened amount of blood, took place before the appearance of sleep.

From another side Hilton pointed out that when the base of the skull is fractured, it is only necessary to compress the jugulars to cause the cerebro-spinal liquid to come out at the ears; while, as every surgeon knows, in a fracture of this kind, it is only during the waking state that the cerebro-spinal fluid flows out from the ears; during sleep it stops, or at all events

[1] Leonard Corning, *Carotid Compression and Brain Rest*, New York, 1882.

[2] Hammond, *Quarterly Journal of Psych. Med. and Med. Jurisprudence*, January 1869.

is greatly diminished. These facts prove indirectly that sleep is accompanied, not by venous stasis, but by contraction of the vessels, that is by cerebral anæmia.

I have already referred to the direct proofs of cerebral anæmia during sleep furnished by Tarchanoff's experiments. This skilful investigator studied directly the cerebral changes which occur during natural sleep in young puppies, and satisfied himself that normal sleep is constantly associated with cerebral anæmia. Every time the puppy fell asleep his brain became pale to a marked degree. All young puppies easily fall asleep when placed in a horizontal position, but Tarchanoff's observations show that they most easily fall asleep when the head is raised, and that the only position in which they will never go to sleep is when the head is depressed below the body. It is evident that this absence of sleep when the head is vertically below the body is explained by stasis of blood in the vessels of the brain, while the facility of sleep in the opposite position is due to reflux of blood from the head, that is to say to cerebral anæmia.

Thus we see that the evidence for the vasomotor theory of sleep has demonstrated that during sleep the cerebral vessels are contracted, and consequently contain less blood. As Hammond, moreover, has pointed out, the influence of cerebral anæmia in causing sleep is also shown by the action of heat, which draws the blood from the internal organs, including the brain, to the skin, thus causing sleepiness; by the action of extreme cold, which has the same effects; by the action of digestion, which draws the blood to the large abdominal vessels and thus produces somnolence; and

also by the tendency to sleep which is well marked in debility and after excessive loss of blood.

Durham believes that we must distinguish in the brain two sorts of circulation : one associated with its activity, the other with its nutrition. When the mind is active, during the first kind of circulation, the capillaries dilate and give admission not only to the serum but also to the red, oxygen-bearing corpuscles, while at the same time endosmosis is increased by the heightened rapidity of the blood; and the increased endosmosis occasions naturally a greater flow into the blood-stream of different products of plastic and gaseous tissue-metamorphosis. At the same time exosmosis is slackened, as he found in his observations on endosmosis and exosmosis in the intestines of the rabbit. During the circulation of nutrition, on the other hand, the blood-stream is slower, the capillaries contracted, and the conditions are favourable to exosmosis, and consequently to the nutrition of the brain. In Durham's opinion these conditions are present during sleep. Kohlschütter expressed the same opinion, comparing the circulation during cerebral activity to that which takes place in the glands during their activity (Claude Bernard).

While speaking of the vasomotor theories of sleep I may mention the hypothesis formulated by Girondeau. Its point of departure is to be found in the discovery, by Boll and Robin, of the lymphatic spaces round the cerebral vessels. Girondeau supposes that these lymphatic spaces are filled with lymph during sleep, and that the vessels are thus compressed, and the circulation retarded. In these lymphatic spaces or sheaths, Professor Boll has constantly found white blood corpuscles in more or less

abundance, and if we bear in mind Professor Tarchanoff's discovery that when animals are immobilised by curare the white corpuscles accumulate in the lymphatic spaces, we may understand why it is that during prolonged hibernation the blood of animals seems completely deprived of white corpuscles. It is evident that under these conditions the same phenomena are produced as under the influence of curare, and during prolonged hibernation the white corpuscles probably accumulate in the lymphatic spaces and channels. It is probable that such an accumulation of lymph in the sheaths of the cerebral vessels would possess a special significance as regards the nutrition and plastic reproduction of the tissues, but the question can only be completely cleared up by further research.

Side by side with these vasomotor theories have arisen the chemical theories of sleep. Thus Sommer has attempted to prove that sleep is caused by impoverishment of oxygen in the brain, appearing as soon as the reserve of oxygen in the tissues and blood is exhausted. He connects his theory with the fact, discovered by Pettenkoffer and Voit, that the absorption of oxygen during the night is greater than during the day, and that it is still further increased by albuminous food. Heynsius, also, has shown that during sleep absorption is more active than in the waking state, but that the accumulation of reserve albumen is retarded, and he explains this by the faculty possessed by acids of retarding the diffusion or exosmosis of albumen, for it is recognised that fatigue always causes the formation of lactic acid and other products of retrogressive metamorphosis, while the alkalis, as Heynsius has also

shown, accelerate albuminous osmosis. Preyer[1] is the chief advocate of the theory that sleep is the direct consequence of fatigue, or rather, of the fatigue products in the blood, these being easily oxidisable substances which absorb the oxygen required by the brain, and consequently that the artificial injection of lactic acid and similar bodies causes sleep. Unfortunately, experiments in this direction have only yielded contradictory results (Preyer, Fisher, L. Meyer, etc.).

Others, and especially Professor Pflüger, have devoted their attention to the part played by carbonic acid during sleep. Pflüger starts from the fact that when the oxygen is used up and is replaced by carbonic acid, activity ceases. The formation of carbonic acid produces a series of violent oscillations and explosions, exciting vibrations in all the atoms around. He compares the process to what takes place in singing flames, and referring to the grey substance of the brain, remarks that it is in the waking state that the vibrations are most powerful and the singing of the flames loudest. Experiments with frogs showed that as soon as the formation of carbonic acid is arrested drowsiness and finally death is caused. It is the brain which requires most oxygen, and when no longer maintained in activity by the formation of carbonic acid sleep ensues. Pflüger meets the difficulty of the long duration of sleep after the brain has recovered its oxygen, by contending that the intra-molecular vibrations of the brain, like the strings of a harp, continue to vibrate long after the blow which has set them in motion, and this

[1] *Ueber die Ursache des Schlafes*, 1877; also art. "Schlaf," Eulenburg's *Real-Encyklopädie*, 2nd ed., Bd. xvii.

is supported by the difficulty with which sleep is obtained after severe exertion.[1] Binz has also shown that various soporifics (lactic acid, morphia, chloroform) display special affinity for the cerebral cortex; on account of this affinity the cortex fixes for a certain period the soporific substances brought by the blood, and in so doing becomes incapable of the processes of dissociation needed to maintain the waking condition.

An attempt has further been made to explain sleep by the accumulation of leucomaines or poisonous alkaloids in the tissues. This has especially been done by Professor Leo Errera of Brussels, in communications made to the Brussels Society of Anthropology in 1886, and again in 1895.[2] He regards sleep as essentially a process of physiological intoxication, taking as his point of departure the facts ascertained by Bouchard and others as to the existence of poisonous alkaloids in the urine and saliva. "Work in the organism," he points out, "is indissolubly bound up with a chemical breaking down. Among the products which result the leucomaines figure. Borne along by the blood, they are without doubt retained by the cerebral centres, and as many of them have a fatiguing and narcotic action, they must at length produce fatigue and sleep. During activity more leucomaines are formed by this breaking down than oxidation can destroy. But during sleep they are destroyed and carried away. Their

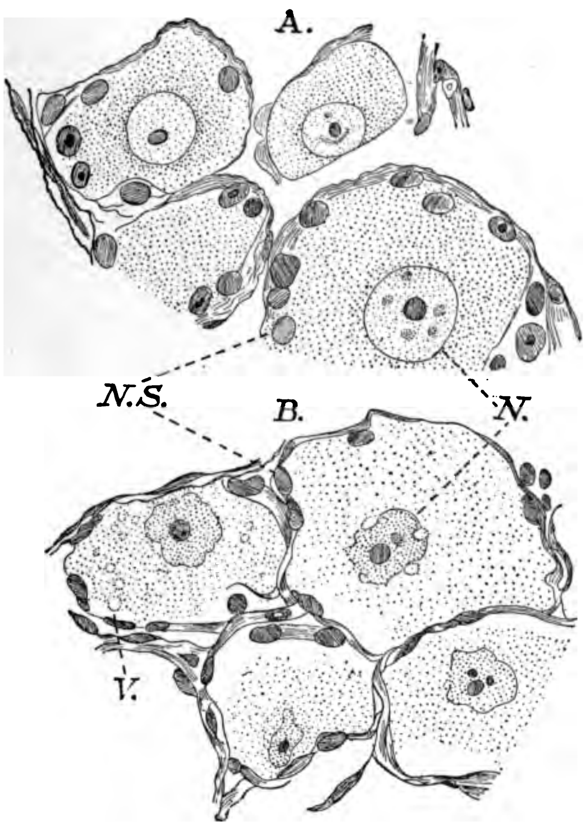
[1] A statement of Pflüger's theory may be found in the *Lancet*, 19th June 1875; also Pflüger's *Archiv. f. d. Ges. Physiolog.*, x. pp. 658 *et seq.*, 1875.

[2] Leo Errera, *Sur le Mécanisme du Sommeil*, Bruxelles, 1895. Laupts has also argued in the same sense, *Ann. Med.-psych.*, Nov. 1895.

oxidation products, having no special affinity for the protoplasm of the grey substance, are washed away by the blood-stream. The nerve cell is thus cleansed, and a slight stimulus suffices to produce awakening. Work, fatigue, sleep, reparation, and awakening are thus not merely successive events, but phenomena chained together in a regular and necessary cycle. The alternations of waking and sleeping, on this hypothesis, are like the rhythmic movements of respiration, or the activity and repose of a muscle." It has been asked by Vanderkindere why, on the chemical theory, excess of fatigue should prevent sleep. Errera justly replies that the properties of toxic substances vary according to the dose, and that while in small doses they can produce narcosis, in large doses they sometimes produce excitement or even convulsions. But the theory does not explain the power we possess of postponing sleep, or of awaking at a fixed hour.

In recent years the chief theories of sleep have been formulated by nerve histologists, who have endeavoured to explain not so much the causes of sleep as its ultimate nervous mechanism. Their theories find some support in the phenomena of cell fatigue as observed by Hodge and others. The first of these theories which deserves mention is Rabl Rückardt's hypothesis of the *neurospongium*, according to which psychic processes are due to the rapid play of the amœboid protoplasmic prolongations of the nerve cells, in perpetual conjunction and rupture of union; while sleep with its dreams, together with hypnotism, etc., is accounted for by partial paralysis of these amœboid prolongations.[1]

[1] Rabl Rückardt, *Neurologisches Centralblatt*, 1890, Heft 7.



Two sections, A and B, from the first thoracic spinal ganglion of a cat. B is from a ganglion which had been electrically stimulated for some hours, A from the corresponding ganglion at rest. The exhausted cells are shrunken. N., nucleus; N.S., nucleus of capsule; V., vacuole; × 500 diameters (Hodge).

A few years later Professor Lépine, in ignorance of Rabl Rückardt's hypothesis, but stimulated by the new methods and results of Golgi and Ramon y Cajal, set forth a similar theory of more definite character. He applied it in the first place to explain the alternations of sensorial anæsthesia, the state in which a person becomes attentive to one point and insensible to all other impressions, and he supposed that certain cerebral cells in the normal state are able to break their communication with the periphery and shut the door on importunate sensations. Sleep, whether natural or provoked, would thus be explained by the retraction of the ramifications of the cerebral cells, and their consequent isolation and inactivity. He explained the varieties of somnambulism on the same hypothesis.[1]

Professor Mathias Duval has set forth a similar theory, also independently; it has, however, attracted far more attention than those already mentioned, partly on account of the author's reputation, partly on account of the greater precision with which it was worked out. Recalling Wiedersheim's observations on the amœboid movements of the nervous cellules of a transparent crustacean, *Leptodera hyalina*, Duval asked if we must not admit that the cerebral neuron and its ramifications is not always comparable to an amœba with its pseudopods, these ramifications elongating and retracting under various influences, and so producing a more or less intimate contiguity of the cerebral neurons. In sleep all these ramifications are retracted. If the sleeper is feebly stimulated the medulla responds by reflex reactions, but the brain remains unresponsive. Stronger stimulation reaches

[1] *Revue de Médecine*, Paris, 1894, p. 727.

the brain by means of chemiotropism—that is to say, the intimate chemical processes set up by the products of metabolism—and the contacts so determined in the extremities of the sensitive neurons; chemiotropism sets up a current of contacts among the pseudopods, and when this current has traversed and shaken nearly the whole brain the sleeper awakes.[1]

Finally, Ramon y Cajal has started a theory which, though suggested by Duval's, has the advantage of being supported by actually observed facts. It differs from the preceding theories by transferring the seat of chief activity to the neuroglia, and involves almost a complete system of physiological mechanics. Cajal regards the neuroglia as possessed of amœboid characters, by virtue of which it is enabled to act as an isolator of the nervous currents. In their state of relaxation the neuroglia pseudopodia extend and intervene between the cells and their protoplasmic processes and the nerve branches, so that the passage of nerve currents is either entirely stopped or considerably impeded. In this way, which the distinguished histologist of Barcelona admits to be largely hypothetical, it is possible to explain the process of natural repose and sleep, as well as of narcotics and hypnotism.[2]

Lately, Howell has set forth a modification of the vasomotor theory of sleep (suggested by his own plethysmographic investigations), which may be thus stated in his own words:—The immediate cause of normal sleep lies in a vascular dilatation of the skin

[1] Duval, "Hypothèse sur la physiologie des centres nerveux; théorie histologique du sommeil," *Soc. de Biologie*, 1895, p. 85.

[2] Ramon y Cajal, *Hipotesis sobre el mecanismo histologico de la associacion del suevo y del estado vigil*, Madrid, 1895. Also His's *Archiv. f. Anatomie*, etc., 1895, Heft. 4-6.

causing a fall of blood pressure in the arteries at the base of the brain, and thereby producing an anæmic condition in the cortex cerebri. This condition of anæmia, in connection with the withdrawal of external stimuli, causes a depression of the psychical processes in the brain cells below the threshold of consciousness. The fall of blood pressure is due, in the first place, to a relaxation of tone in that portion of the vasomotor centre controlling the skin vessels. The immediate cause of normal awaking, on the contrary, is found in the augmented flow of blood to the brain that follows upon the gradual constriction of the skin vessels as the vasomotor centre recovers its tone. The periodicity of sleep is therefore directly connected with a rhythmic loss and resumption of tone in the vasomotor centre. Throughout the waking period the vasomotor centre is under continual stimulation, and is therefore in continual activity. Sensory impulses, especially from the skin and the cutaneous sense organs, are at all times falling into the central nervous system in greater or less quantities, and through a reflex pressor action on the vasomotor centre these sensory impulses keep up a constant activity of the centre, particularly of that part controlling the skin vessels, as is indicated by the striking effect of such stimuli upon the volume of a limb when measured plethysmographically. Mental activity in all its forms is accompanied by a similar pressor effect upon the vasomotor centre, which is likewise known to affect the skin circulation. During the waking hours, therefore, the vasomotor centre is in uninterrupted activity, and the result must be the production of a condition of fatigue in this centre *proportionate* to the amount of stimulation. If the

fatigue is sufficiently pronounced, the centre will relax and sleep ensue, in spite of even strong sensory or mental stimuli. If the fatigue is less marked, as is normally the case at the end of a waking period, adequate relaxation takes place only after the withdrawal of sensory and mental stimuli, and our voluntary preparations for sleep consist essentially in devices to minimise these stimuli. That the vasomotor centre is susceptible to fatigue, Howell believes from his own experiments in the continuous stimulation of sensory nerves (sciatic) in curarised and narcotised animals. The great rise of blood pressure that results from such stimulation soon passes off more or less completely, and that this result is owing to fatigue of the centre rather than to fatigue of the muscles in the walls of the blood-vessels is indicated by the fact that the blood-vessels in the ear of a rabbit may be kept in a condition of strong contraction for a long period (over an hour at least) by constant tetanic stimulation of the peripheral end of the cervical sympathetic nerve. In addition to the effect of the cerebral anæmia, Howell holds that an accessory favouring condition to the production of sleep may be found in a certain degree of fatigue of the parts of the brain mediating psychical processes. Portions of the sensory and the association areas of the cortex, using Flechsig's nomenclature, must be active during the greater part of the waking period, and probably, therefore, lose their irritability to a greater or less extent. Upon the withdrawal of the normal blood supply, their irritability will tend to fall more quickly below the threshold of consciousness in consequence of this fatigue. We might, therefore, say that three factors combine to produce

normal sleep: 1. A diminution of irritability, caused by fatigue, of large portions of the cortical area. 2. Voluntary withdrawal of sensory and mental stimuli involved in the preparations for sleep. 3. A diminished blood supply to the brain, owing to a relaxation of tone in the vasomotor centre and the fall of general arterial pressure thereby produced. The last factor Howell regards as the immediate cause of sleep, explaining its comparatively sudden and nearly simultaneous occurrence over the entire cortex.[1]

If we except the largely hypothetical explanations based on nervous histology, the chief theories of sleep,[2] as Wundt has pointed out, possess the common defect that they neglect its fundamental and direct cause. The blood-vessels were made for the brain (as Crichton Browne well remarks), and not the brain for the blood-vessels, and the amount of blood in the brain is regulated by the functional activity of the nervous tissues. According to Pflüger's theory, again, sleep ought to affect the entire organism and the whole central nervous system; but, as we have seen, that is not the case, for the spinal cord and the nerves do not sleep. It is necessary, as Wundt has shown, to distinguish the essential from the secondary phenomena of sleep. With reference to the chemical theories which explain the appearance of sleep by the accumulation in the organism of the products of fatigue, we must remember that mere boredom or monotony, in the absence of all fatigue, is sufficient to cause sleep. If we analyse this fact we realise that

[1] W. H. Howell, "A Contribution to the Theory of Sleep," *Jour. of Experimental Medicine*, 1897.

[2] For a bibliography of the theories of sleep see Sante de Sanctis, *I Sogni e il Sonno*, 1896, pp. 48 *et seq.*

ennui must induce sleep precisely because it removes all the varied impressions and sensations which stimulate our attention and supply ever new material for the elaboration of thought.

This leads us to the phenomenon of yawning, which occurs under the circumstances just described, and may help to throw light on our present problem. What is a yawn? Externally, the yawn consists of a slow and deep inspiration while the mouth is more or less widely open, and it is followed by a slow expiration which is accomplished with gaping mouth and more or less contracted glottis, thus producing the well-known sound which accompanies every regular yawn. That is the external side of a yawn. In its internal mechanism, according to Mosso, it depends on a fatigue of attention. This explanation is corroborated by the well-known fact that, *cæteris paribus*, yawning appears most frequently in invalids weakened by loss of blood, and also in subjects with an unstable nervous system, for instance the hysterical. In short, yawning appears most readily when consciousness is feeble and quickly fatigued. Thus many persons suffering from anæmia begin to yawn and grow sleepy when they remain long in an upright position, either seated or standing, and as soon as they assume a horizontal position their yawns and desire for sleep disappear. In presence of these facts, it is reasonable to conclude that there must exist a more or less intimate connection between yawning and cerebral anæmia.

Energetic yawning always accompanies stretching of the body and limbs, and Mosso considers that the latter movement is due to an instinctive desire to avoid localised stasis of blood, and that, in general,

we experience the need to stretch the limbs whenever the blood is irregularly distributed throughout the body.

That, however, yawning and stretching are really due to fatigue of attention finds confirmation in my investigations into the antagonism between attention on one side and movement—indeed all motor innervation—on the other. These investigations were made in collaboration with Dr. Wartanoff, with the aid of the graphic method. They have demonstrated that all activity of attention is translated externally by an afflux of blood to the brain, and corresponding diminution in the volume of the arm; but if the subjects be made to execute some habitual movement (as with eyelids or tongue) the ordinary effects of attention on the vessels of the body are abolished. It was the same when the subjects concentrated their attention on some minimal sensation of hearing or touch while imagining some movement to themselves, without, however, reproducing it; in that case also, attention was not translated into a diminution in the volume of the arm.[1]

These experiments proved to me that between active attention and all sorts of movements and motor innervations there is complete and absolute antagonism, and consequently that yawning and stretching may very well be due to the motor reaction of the organism against prolonged attention. On the other side, Ludwig Böhm has remarked that every concentration of attention leads to squinting in

[1] Marie de Manacéïne, "De l'Antagonisme qui existe entre chaque effort de l'attention et des innervations motrices," *Atti del' XI. Congresso Medico* (Rome, 1894), vol. ii ; also *Archives italiennes de Biologie.*

persons having a predisposition to it. This is explained by the antagonism of motor innervations and attention, because in squinting persons one group of muscles are stronger than their antagonists, and consequently the latter need a more powerful innervation to keep them in activity, and as every concentration of attention is opposed to movement and motor innervations, squinting appears as the weaker muscles cease to receive the necessary innervation. It is for the same reason—*i.e.*, because movement destroys attention—that we cry or groan, move our body or agitate our limbs, to lessen pain and discomfort. While attention is at its height it may stifle movement, but as soon as it is fatigued the reaction sets in and the need of movement shows itself in reiterated yawns, in the desire to stretch the body and limbs. Thus Mosso's explanation of the internal mechanism of yawning seems to be entirely just.

We have already seen that an arrest of consciousness may always be observed in the sleeper, and if we wish to understand the nature and causation of sleep on the psychic side we must study consciousness itself. From this point of view the cause of sleep may be stated in the formula: Sleep is the resting-time of consciousness.

If this formula is correct, persons in whom consciousness is little developed should sleep more than persons endowed with a more pronounced and clearly defined "ego," since the development of the notion of our ego is intimately and directly connected with that of consciousness.

To study the phenomena of consciousness we must first of all observe children, in whom the conscious

side of psychic life is necessarily less developed than in adults. Now sleep, as every one knows, lasts longer in children, and they fall asleep much more quickly and easily than adults. Among adults also, in civilisation, we may observe that the least developed and least cultured persons are those who need most sleep. Confirmation may also be found in observations on savages, who, as Dugald Stewart remarked, fall asleep as soon as they are unoccupied and nothing in the external world fixes their attention. Miclucho-Maclay once informed me that the Papuans sleep much, falling into slumber as soon as they have nothing to do, and that in the strangest positions, not only when seated but also when upright. We may note also that cretins, as, for instance, Brierre de Boismont remarked, sleep excessively, and it is unnecessary to observe that in them consciousness is developed to an extremely feeble degree.

Finally, this hypothesis as to the nature of sleep finds another proof in the fact, often demonstrated, that animals deprived of their brains, and consequently of all consciousness analogous to ours, never sleep.[1] Fick has dealt with this subject, and Neumann expressly points out that sleep is the less necessary to an animal the more the spinal cord predominates

[1] It must be added, however, that of recent years this has been questioned. Thus Belmondo ("Alcune Idee sui Processi chemici nel Cervello," *Archivio per l'Antropologia*, 1895) remarks that a sleeping animal is not perfectly equal to an animal without a brain, "and that for the excellent reason that periodical sleep is not wanting in the lower vertebrates, such as fishes, in which the brain is very slightly developed and the psychic functions rudimentary, and also in animals deprived of brains. This observation," he continues, "first made by Flourens, then by Schiff, by Goltz in his famous brainless dog, by Stefani in pigeons, and confirmed by Baratynsky, I have myself repeatedly observed in my [brainless] doves, which showed alternate periods of

over the brain, and reflex movement over conscious and voluntary movement.

To appreciate all the importance of this fact, it must be remembered that animals deprived of the brain must necessarily lack that marvellous faculty which we call self-consciousness, which is consciousness of all the various phenomena of psychic life. In saying that the lower animals are without consciousness, it is not meant that they are completely lacking in every form of consciousness, but only that in them consciousness is in so slightly differentiated a state, that it is impossible even to divide their conscious and voluntary from their unconscious and reflex actions, so that many authors, including the illustrious Wundt, go so far as absolutely to deny the existence of reflex movements in the lower animals. It is true that every action and movement, in order to become mechanical, must first have been conscious and voluntary. The consciousness of the lower animals is, however, so little developed that it is impossible to distinguish it from other psychic aptitudes. To understand this undifferentiated psychic condition we must recall analogous periods in the development of the psychic life of organisms, as in those groups of animals in which

agitation and immobility which, however, were in direct relation with the fulness or emptiness of the crop. When this is empty, and the organism, although the cerebral hemispheres are absent, feels the vague stimulation of hunger, the animal is agitated and restless; if fed it becomes calm, closes the eyes, resumes the characteristic attitude described by Dalton, and remains motionless for hours during digestion. In brainless pigeons kept without food, the periods of agitation and calm seem to me much less regular. But in any case, sleep is not a purely cerebral function, as some believe; the whole organism sleeps, and the brain also, in my opinion, only sleeps because the organs of sense sleep."

the living protoplasm appears one and indivisible, that is to say absolutely deprived of all differentiation into separate organs and tissues, accomplishing by itself every necessary function of life,—respiration, movement, sensibility, absorption. It goes without saying that under such conditions it is impossible to imagine that this or that function of the protoplasm can be completely fatigued, for all fatigue must be generalised throughout the mass and occasion a temporary arrest of all the vital functions. In presence of such facts it is natural to suppose that periods of activity and repose must be strictly balanced under these conditions, and that consequently these forms of organic life have no need of any accessory form of repose in the form of sleep.

As soon as consciousness is differentiated from the other psychic functions, it is so often put into action that the periods of repose which regularly follow periods of activity become insufficient for the complete restitution of the exhausted energies of consciousness, and sleep, in periods more or less lengthy and frequent, becomes increasingly necessary. The weaker consciousness is, the more easily it is fatigued and in need of sleep; an energetic consciousness, on the contrary, is contented with periods of sleep that are shorter, less deep, and less frequent. I have already referred to children, and would only add that, as every one may observe, the younger children are the more profoundly they sleep.

The meaning of the statement that sleep is the resting-time of consciousness is well illustrated by the observations made in 1828 on a certain Caspar Hauser. This subject had passed his childhood and

part of his youth in absolute solitude, so that he had never seen either men or animals, or plants, or the sky, the sun, the stars, the moon. At seventeen or eighteen years of age he was brought to Nüremberg and abandoned in the middle of a street. At this age his development was that of a baby, for he could neither walk, see, nor speak, as was at once observed by the people who found him, and verified by the detailed observations of his teachers. So many varied impressions and new sensations produced such a strong effect on him during the first period of his life at Nüremberg that he suffered considerably, and even longed to be again shut up in the complete solitude of the gloomy little room in which he had passed so many years of his life. Now this Caspar Hauser, during the first months of his life among men, slept so profoundly that it was almost impossible to awaken him. He always fell asleep as soon as the sun set, as easily as a baby, even more easily, for it was enough to lead him outside the house to send him to sleep, even when he was in a jolting vehicle, in spite of the noise of the wheels and the movement. His consciousness received so many new and unaccustomed sensations that it quickly became fatigued and exhausted, and hence the irresistible tendency to sleep.

If we wish to investigate this question further we may study the phenomena presented in old people, some of whom sleep much and soundly, while the sleep of others, of the same age, is light or brief. These differences cannot be explained by the chemical or vasomotor theories of sleep, for the products of metabolism must still be formed, and at the same time the vasomotor system must be modified by age,

and yet sleep in these old people presents diametrically opposite characters. But if we regard sleep as the resting-time of consciousness these differences are easily explained. In those old people whose conscious life grows feeble with the years, consciousness must be quickly exhausted; hence more or less predominance of sleep. At the same time there is a more or less notable enfeeblement of conscious memory: thus Struve, the illustrious Russian astronomer, during the last years of his life gradually lost his memory for recent events, while well remembering earlier events. As an example of the extent to which sleep may predominate in old age, I may mention the case of the French mathematician, Moivre, who was continually obliged to increase the time devoted to sleep, until at last he slept for twenty hours a day, leaving only four for science and the other occupations of conscious life.

On the other hand, old men who preserve their consciousness in full vigour are subject to insomnia, as is natural, for the conditions of old age are such that consciousness has no occasion to exercise itself to the same degree as in the past, and since it still preserves its vigour intact in spite of the years, does not become sufficiently fatigued to feel the need of long and profound repose.

Thus the psycho-physiological statement which I have formulated above seems to explain sufficiently the modifications of sleep according to age and individual development. I may also remark that persons with very marked personality and highly developed consciousness have relatively little need of sleep, precisely because such a consciousness is *capable* of producing considerable work. Thus we

know that Humboldt, Mirabeau, Schiller, Frederick the Great, and Napoleon slept very little.

After all that has been said, it is not surprising that the capacity for sleep should be denied by many authors to the fœtus during intra-uterine life.

The Necessity for Sleep.—In the following chapters we shall often find evidence of the truth of the statement that sleep is the resting-time of consciousness. Here I only wish to dwell for a short time on the question whether general sleep is necessary. Considering that not only different organs and tissues, but also various apparatus of the central nervous system are able to perform their functions during sleep, we might conceive doubts as to the necessity of sleep. And such doubts have actually been raised, and sleep declared a useless, foolish, even hurtful habit (Girondeau[1]). We have, therefore, to inquire whether it is possible to do without sleep.

To this question we can give a positive answer, for want of sleep is not even so well borne by animals as want of food. Direct experiment has shown that animals entirely deprived of food for twenty days, and which have then lost more than half their weight, may yet escape death if fed with precaution—that is to say, in small amounts often repeated. On the other hand, I have found by experimenting on ten puppies that the complete deprivation of sleep for four or five days (96 to 120 hours) causes irreparable lesions in the organism, and in spite of every care the subjects of these experiments could not be saved. Complete absence of sleep during this period is fatal to puppies in spite of the food taken during this

[1] Girondeau, *De la Circulation cérébrale intime dans ses rapports avec le sommeil*, Paris, 1886.

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time, and the younger the puppy the more quickly he succumbed. In animals deprived of sleep for a considerable period, we may observe a lowering of temperature and a marked decrease in the number of the red and white blood corpuscles, the latter no doubt because arrested in the lymphatic channels. During the last days of such an experiment the blood becomes notably thickened, while the red corpuscles and the amount of hæmoglobin are increased. This is due to the fact that eventually the animal refuses to eat or drink, while the kidneys continue to act. At the same time as the temperature of the body begins to fall, the reflex movements that the animals manifest on being pinched become more and more enfeebled and slackened. These changes of reflex movement show themselves periodically first on one side of the body and then on the other, which might indicate that the two hemispheres are, in these conditions, acting in turn. The pupils become irregular, the reactions slower, and there is a certain periodicity in the phenomena observed; that is, the pupil on the side which shows itself insensible to irritations does not react to light, this state of the pupil showing itself periodically first on one and then on the other side of the body. At the same time serious derangement of nutrition may be observed. As a rule, the puppy deprived of sleep for three or four days presents a more pitiful appearance than one which has passed ten or fifteen days without food. I can speak from observation, as I was obliged to make experiments on the results of want of food as well as of sleep, and I became firmly convinced that sleep is more necessary to animals endowed with consciousness than *even food.*

It is interesting also to note that in deprivation of sleep it seems to be the brain which suffers most, while in complete deprivation of food it is the brain which longest preserves its normal weight and constitution, the other organs and tissues undergoing profound modification and remarkable diminution in volume. Judging from experiments on puppies of from two to four months old, we may conclude that want of sleep acts primarily on the cerebral centres, in which it provokes a series of pathological changes.[1]

These investigations have lately been carried a step further by Professor Patrick and Dr. J. A. Gilbert, of the Psychological Laboratory of the University of Iowa. In view of the fact, as they remark, that our knowledge of the physiological and mental effects of enforced abstinence from sleep is solely confined to my experiments on dogs, they resolved to experiment on the human subject. Their subjects were teachers in the University, and it was proposed to keep them awake continuously for about 90 hours, making physiological and psychological tests upon them at intervals of 6 hours, in respect to reaction time, discrimination time, motor ability, memory, attention, etc.; to observe the general effects of insomnia, and also the depth, amount, and character of the sleep that finally resulted. This plan was successfully followed with three subjects, who were constantly attended by one or two watchers. The first subject, an assistant professor at the University, in perfect health, suffered much from sleepiness during the second night, the time of dawn being

[1] Marie de Manacéïne, "Observations expérimentales sur l'insomnie absolue," *Arch. ital. de Biologie*, 1894. Also, *Atti dell' XI. Congresso Medico* (Rome), vol. ii., Fisiologia, p. 174.

that of greatest somnolence, but not nearly so much during the third night. In his case the most marked effect (not seen in the other cases) was the presence of hallucinations of sight; the air seemed full of dancing particles like gnats—coloured red, purple, or black—which he would try to catch. He had never had hallucinations before, and they disappeared entirely after the experiment was concluded. In all three cases there was a steady increase in weight during the experiment, followed by a marked decrease after sleep. (In my experiments the dogs were only weighed at the commencement of the experiment and after death; and it was then found that there had been a decrease in weight; it was, however, only slight, from 5 to 13 per cent.) The dynamometer showed a steady decrease in strength of both grip and pull, regained after sleep. The reactions became slower, except in one case. Acuteness of vision in all three cases uniformly *increased* during the experiment, dropping to below the normal after sleep. Memory became very defective, and power of attention was largely lost: one subject found it impossible to commit to memory in twenty minutes what normally took him two minutes. In only one case did it appear that there would have been danger in prolonging the experiment over 90 hours; in this case the temperature fell three degrees below normal after a brisk walk in the cool morning air, but soon rose again. The most interesting feature of the experiment was the ease and rapidity with which sleep brought complete restoration. The subjects only found it necessary to make up from 16 to 35 per cent. of the time lost from sleep. This *was partly* due to the greater depth of the resulting

sleep, partly to the fact that even when apparently awake the subjects were sometimes partially asleep; thus, one reported a dream while he was standing up gazing at a piece of apparatus. Analysis of the urine showed that there was increased excretion of nitrogen and phosphoric acid, relatively more of the latter.[1]

Thus, although in man the effects of enforced sleeplessness are less permanently injurious than in dogs, the nature and gravity of these effects are now established. Empirically they were known in antiquity, as well as in China, where forced deprivation of sleep was a form of torture, and even of capital punishment.

In presence of this inevitable necessity of sleep for beings possessed of a central nervous system, we are forced to conclude that conscious life needs for its accomplishment an expenditure of energy so intense that while it is being effected the processes of nutrition and the reconstitution of the tissue cannot be completely carried on, and that sleep—the repose of consciousness—is needed for the plastic nutrition of the organism and the accomplishment of its vegetative life. Self-consciousness is the highest of our faculties, that which renders possible a moral ideal and scientific knowledge; it is not, therefore, surprising that conscious life should require the greatest effort of the organism, and that when consciousness is wanting sleep becomes useless.

At the same time we must remember that sleep is not an absolute arrest of cerebral activity. The

[1] Professor Patrick and Dr. J. A. Gilbert, "On the Effects of Loss of Sleep," *Psychological Review*, September 1896. Full tables of results for each subject accompany the paper.

brain remains partially active, only sleeping in so far as it is the anatomical basis of full consciousness. Byron was certainly right when he said that our life is composed of two distinct existences, for sleep is a world apart:

> "Our life is twofold; sleep has its own world,
> A boundary between the things misnamed
> Death and Existence: sleep has its own world."

It is necessary to study seriously and fundamentally this part of life, for on that study depends the solution of other essential questions of our existence.

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CHAPTER II.

THE PATHOLOGY OF SLEEP.

Brief and Intermittent Sleep—Complete Insomnia—The Conditions of Insomnia—Afflux of Blood to the Brain—Insomnia among the Anæmic—Unconsciousness excludes Insomnia—Division of Consciousness causes Insomnia—Stimulation of Consciousness as a cause of Insomnia—Why Pains and Neuralgias disappear during Sleep—Hypnotics and Anæsthetics—Syncope—Excessive tendency to Sleep—Part played by the Sensations—Influence of Day and Night in Inanition—Hibernation—Summer Sleep—Narcolepsy—Endemic Narcolepsy in Africa—Metabolism weakened in Narcolepsy—Enfeeblement of Sensibility—The Cataleptic State—Napoleon's Fits of Narcolepsy—Treatment of Narcolepsy—Absence of Dreams during the Narcoleptic Sleep—The frequency of Convulsive Disorders during Sleep—Automatism—Consciousness and Attention—Injurious influence of Prolonged and Monotonous Occupations—Heightened Reflex Activity—Automatism—Suggestion and Psychic Epidemics—Latah—Hypnosis a pathological form of Sleep—Somnambulism—State of the Sensory Organs during Somnambulism—Hysterical Somnolence—Double Personality—Its possible Explanation—The Theory of the Double Brain.

WHEN we come to study the pathology of sleep, we are met at the outset by the question: In what do the pathological modifications of sleep consist? If we consider any bodily function we always find that the morbid changes are translated into enfeeblement or over-excitement of action. In sleep, similarly, we may find either weakened or excessive *activity*, and we will consider the former case first.

Insomnia.—When the power of sleep is weakened it becomes light and fugitive, so that the slightest noise, the least impression from without, may suffice to waken the sleeper. Such sleep is obviously hurtful, since the nutrition of the tissues must be interrupted when it is scarcely begun, and is never allowed to proceed in peace. The injurious effects of this sleep have been noted by various authorities, especially Bouchut. Such broken sleep is often observed in persons who laugh and cry easily, who frequently blush, and whose pulse is quickened by the most insignificant cause, or even by no obvious cause at all; it is found, in a word, in those subjects in whom the nervous system is ill-balanced and the vasomotor apparatus extremely irritable.

Most cases of insomnia belong to this class, and Hammond rightly warns physicians not to attach too much faith to the assertions of patients who maintain that they are entirely without sleep, for such subjects are usually suffering not from absolute insomnia, but from insufficient sleep. Complete insomnia is very injurious to the health of the whole organism, and especially of the brain, and psychic derangement, more or less serious, may result (Renaudin).

Cases of complete insomnia are, however, met, but they quickly terminate in death. Such cases have been described by Hammond, who observed, for instance, in one patient complete absence of sleep during nine days; on the ninth day death put an end to his sufferings. After the experiments on animals and men already quoted, this fatal result cannot astonish us.

Under what conditions is insomnia usually observed? We have already seen that it is common

in subjects with an unbalanced and irritable nervous system. Such subjects are characterised by a marked tendency to hyperæmia of the head; they blush frequently, an indication that the blood is flowing towards the head (Bouchut, Nagel).

In analysing the conditions of sleep we have found that, above all, a certain degree of anæmia of the brain is necessary; it is easy to understand, therefore, that persons who are liable to a flow of blood to the head are at the same time liable to insomnia. And at the other extremity an undue cerebral anæmia or extreme depression of the general arterial tension will also produce sleeplessness. This has been well shown by the experiments of Maurice de Fleury, using Verdin's sphygmometer applied to the radial pulse. He found that if in the waking condition the normal arterial pressure was equal to 17 centimetres of mercury, during calm sleep the pressure sunk to 11 cm. If the pressure was a little above or a little below this amount the sleep was partial or restless, or disturbed by dreams. If the pressure was still more abnormal—for example at 20 to 25, or at 4 to 6—there was complete insomnia, such as is found among the insane or the extremely anæmic.[1]

Excessive intellectual labour is a recognised cause of insomnia, as also is over-strain due to physical work (Mahomed). Facts of this kind explain themselves, since all over-strain, especially if cerebral, may provoke a dilatation of the vessels of the brain so considerable, that in the absence of corresponding nutrition of the tissues it takes the form of a temporary paralysis of the blood-vessels (Durham); in this case the vessels of the brain are incapable of

[1] Maurice de Fleury, *L'Insomnie et son Traitement*, 1894.

contracting, and the lymphatic channels surrounding them are not supplied with nutritive lymph. In my work on mental over-strain[1] I have already had occasion to analyse the insomnia which develops under the influence of an excessive dilatation of the cerebral vessels by the weakening of the tone of the vessel walls.

Extreme physical fatigue may also produce insomnia, and Mahomed supposes that under these conditions the insomnia is due to stronger action of the heart, which consequently sends a more considerable amount of blood to the brain. In a subject he observed the blood pressure increased notably after the excessive physical work involved in a walk of 500 miles. This subject could not sleep until his heart had begun to beat more tranquilly.

Eustace Smith has mentioned that cold often causes an attack of sleeplessness even in young children, who generally enjoy excellent and profound sleep. It is evident that in adults the same conditions may much more easily produce insomnia, as is natural when we remember that cooling of the extremities always involves a greater flow of blood to the internal organs, among others the brain.

After what has been said it will be understood how every considerable stimulus—such as intense joy or anxiety—may occasion insomnia when felt towards evening. Russell's observations showing that prisoners lose much weight during the trial but not after the sentence, however severe it may be, will not surprise us when we know that any anxiety or agitation may render impossible the sleep that is required for the nutrition of the tissues and the restoration of

[1] Marie de Manacéïne, *Le Surménage Mental*, Paris, 1890, ch. i.

what is lost by the organism during the waking hours.[1]

There can be no doubt that insomnia develops under the influence of all the feelings and emotions which, like joy, anger, or anxiety, cause a flow of blood to the brain (Handfield-Jones, Lidell, etc.). A physical cause may act in the same way, and the Marquise de Châtelet, in writing her memoir *Sur la Nature du Feu*, combated her fatigue by plunging her hands in ice-cold water, a method, indeed, which is widely known and which acts by sending the blood to the head. On the same principle, various authorities have successfully treated insomnia by the application of cold compresses to the head, or by enveloping the entire body in wet sheets (Becker and Schüller). I have myself obtained excellent results, in cases of insomnia due to mental over-strain, by applying an india-rubber bottle of cold water to the forehead.

All these methods act favourably on insomnia because, on the one hand, they provoke contraction of the cerebral vessels, or, on the other, dilatation of the vessels of the skin, and thus determine a secondary and consecutive contraction of the vessels of the brain. It is thus that hot baths taken at night cause sleep by producing dilatation of the peripheral vessels of the skin and consequently relative anæmia of the brain.

Observations on anæmic persons are of special interest from the present point of view, as they show

[1] J. Russell, "On Sleeplessness," *Brit. Med. Journal*, vol. ii., 1861. I may also mention the case reported by Solberg of a boy of eight who developed insomnia as a result of anxiety caused by his approaching examinations. The insomnia resulted in a serious illness (*Allgem. Zeitschrift für Psychiatrie*, 1871).

that the anæmic experience more or less sleepiness when they are standing, but when they go to bed the horizontal position alone often suffices to disperse the tendency to sleep and bring on insomnia. This may easily be explained. The blood-vessels in anæmia are lacking in tonicity, and consequently in the horizontal position the blood settles in too great amount in the head, while in the vertical position there is a stasis of blood in the lower limbs and the abdominal organs. It is also recognised that some anæmic subjects fall asleep immediately after eating, a fact which is explained by the experiments of Durham, who showed that the introduction of food into the stomach caused a well-marked contraction of the cerebral blood-vessels. It will be necessary to return to this subject in the following chapter.

The application of electricity to the head may also remove the tendency to insomnia (Beard and Rockwell) by causing contraction of the cerebral vessels. Hammond obtained marked tendency to somnolence by galvanising the sympathetic nerve; at the same time the retinal vessels contracted, and, consequently, the cerebral vessels; for, although the fact is disputed, there is some reason to believe that there is a certain amount of correspondence between the retinal circulation and the cerebral circulation (Bouchut). Hughlings Jackson, examining the retinal vessels of waking or semi-sleeping children by the ophthalmoscope, has found that they varied considerably, being sometimes contracted, sometimes large, but they were contracted when the child was somnolent or sleeping, while repeated awakenings were always accompanied by dilatation.

Thus we see that not only is normal sleep accom-

panied by anæmia of the brain and contraction of the cerebral vessels, but that whenever there is a flow of blood to the head insomnia results. So that if sleep represents the resting-time of consciousness, consciousness demands, above all, a considerable flow of blood to the head. It seems almost superfluous to cite any further proof of this statement. I may, however, recall a few well-known facts; such as the abolition of consciousness which follows a considerable loss of blood, the enfeeblement of consciousness which occurs in goître, or enlarged thyroid, long since noted by Schröder van der Kolk, the gland withdrawing blood from the brain. All cretins are goîtrous and suffer from vascular impoverishment of the brain. To the same order of facts belongs an observation, by Dickson, of a very anæmic boy who, when standing or sitting, showed a remarkable degree of sleepiness and mental weakness, but when placed in the horizontal position became more lively and intelligent.

Thus the exercise of consciousness requires an active circulation of blood, all the more active since it must necessarily be reflected in the function of other organs. Experiments with the dynamometer have shown that muscular force is notably weakened when the subject is absorbed in conscious mental work, such as the solution of an arithmetical problem (Loeb). It is also recognised that mental work is injurious after dinner, simply because all conscious mental work causes a flow of blood to the brain and consequently interrupts the normal course of digestion by producing a relative anæmia of the digestive organs.

It remains to show under what mental conditions *insomnia is* observed. The intimate connection of

sleep and consciousness is illustrated by the fact, among others, that there is absolute absence of insomnia in the unconscious state. Abolition of consciousness, from whatever cause, always throws the subject into a state which, in appearance, resembles sleep, but is distinguished from it in many essential particulars. This semblance of sleep is equally well observed in cases in which the abolition of consciousness is caused by a shock to the brain, as in those in which it is the result of hæmorrhage into the cerebral substance, or excessive venous stasis. Insomnia is thus impossible in the unconscious state.

On the other hand, it is alleged that the most rebellious and complete insomnia is observed in mental disorders, and especially in disorders characterised by an apparent doubling or division of consciousness, a lack of unity in self-consciousness. This is natural, for the division of consciousness must be associated with a loss of unity in its functional basis, and consequently it can only be active at certain parts; the general fatigue of consciousness thus becomes impossible; and as sleep is only the repose of fatigued consciousness, in such cases the divided consciousness only in part grows weary and sleeps, and thus an obstinate insomnia results.

In persons suffering from neurasthenia partial insomnia may often be observed; at the same time their consciousness is often doubled, or divided in several parts, losing all unity. Such persons often change their opinions and convictions, their sympathies and antipathies, though the lack of unity in their consciousness never reaches the intensity observed in persons afflicted by mental diseases,

their insomnia also is much less than among the insane.[1]

Insomnia is also observed in cases of extreme excitement, as, for instance, after considerable mental effort or excessive anxiety; under such conditions conscious thought works actively, seeking to divine all possible unfavourable contingencies and to find the best methods of defeating them.

Insomnia often depends on intense physical pain. Such cases also illustrate the proposition that sleep is the resting-time of consciousness, for when a painful stimulus becomes sufficiently strong to reach consciousness sleep is impossible, for an actively waking consciousness cannot simultaneously repose. It is thus that we generally find the most various pains disappear when sleep comes, precisely because of the abolition of consciousness during sleep. According to the eminent American neurologist, Weir Mitchell, all varieties of neuralgia are rarest between midnight and seven o'clock in the morning, the hours chiefly devoted to sleep. Erichsen has remarked that those who are asleep during a railway accident are more apt to escape shock to the nervous system than their less fortunate waking fellow-passengers. Cases are quoted in medical literature, especially by Hammond, in which necessary operations have been performed on persons asleep under the influence of great fatigue. In such cases the opera-

[1] Neurasthenia is, however, one of the chief causes of insomnia when we put aside insanity. Macfarlane finds that of 167 cases of insomnia (71 in men and 96 in women), 19 were due to neurasthenia, 19 to chronic gout, 17 to overwork, 17 to worry, 10 to alcoholism, 10 to non-gouty dyspepsia, 8 to the menopause, etc. The most usual age of these cases was between 40 and 50. (A. W. Macfarlane, *Insomnia and its Therapeutics*, 1890.)

tion is effected without the patient's knowledge. Whenever we awake under the influence of pain, as for instance, toothache, it seems to us generally that the pain revives after we have awakened; this illusion is due to the fact that consciousness has now become active, and consequently able to perceive the full force of painful irritations.

The connection of painful sensations with consciousness is also illustrated by the effects of the so-called narcotics and anæsthetics, such as opium, chloral hydrate, chloroform, etc. These drugs, and others of the same class, diminish pain only by reason of their enfeebling action on consciousness, which in certain doses they may temporarily annihilate, and as sleep also consists in a temporary arrest of consciousness, these drugs have been called hypnotics.[1]

If we examine the matter, however, we soon realise that the action of narcotics presents none of the characters observed during normal sleep, except one only, the temporary arrest of consciousness. We may also remark that, like normal sleep, the state of narcosis may be interrupted by a very strong painful stimulus which recalls consciousness into activity. For this reason the surgeon requires a deep and prolonged state of anæsthesia in order to perform a major operation. Cases are also known in which men whose consciousness was enfeebled by the fumes of alcohol have been suddenly restored to the sober state by the influence of pain, as from a broken bone

[1] It would be out of place to enter here into a discussion of the therapeutics of hypnotic drugs. An able summary of the character and effects of the various narcotics and hypnotics will be found in the article by Ringer and Sainsbury on "Sedatives" in Tuke's *Dict. of Psych. Med.*

(Erasmus Darwin). In short, the effect of narcotics only resembles sleep by producing a temporary interruption of consciousness. At that point the resemblance ceases, and observations on morphiamaniacs and opium-eaters, who have grown so accustomed to their narcotic that they cannot sleep without it, even seem to show a certain antagonism between the action of narcotics and sleep; otherwise it is difficult to explain why the habitual use of such drugs should lead to the loss of the power of normal sleep.

It must not be forgotten, also, that those persons who sleep more than is necessary, gradually become accustomed to this excess of sleep, so that at length it becomes absolutely necessary to them, and the act of falling asleep becomes constantly more easy. We might imagine that this would apply to the drugs called hypnotic or soporific (morphia, chloral, etc.), if such drugs were really sleep-bringing; but experience shows that this is not so; the prolonged use of such drugs renders sleep impossible without their aid, and at the same time sleep becomes more and more refractory to these effects, so that the dose must be continually augmented, until the victim at last cannot dispense with the drug, either waking or sleeping, although it is undermining both his physical and mental health. To appreciate the value of normal well-developed consciousness it is sufficient to look at a single morphinomaniac or opium-eater. Such subjects show, under the influence of repeated enfeeblement of consciousness from the use of their favourite drug, a progressive destruction of physical, mental, and moral health, precisely because the *habitual* use of narcotics has rendered impossible

both the active work of consciousness and normal sleep, with the nutrition and repair which are accomplished during sleep. It is evident that narcotic sleep cannot be identified with the normal and natural sleep of a healthy organism.

In the same way syncope may produce a temporary interruption of consciousness, but there is nothing in common between syncope and sleep, for in syncope we observe a simultaneous depression of the cardiac, respiratory, and nutritive activity. The resemblance between syncope and sleep is reduced to this, that in both we find an interruption of consciousness due to anæmia of the brain; and for this reason we treat faintness successfully by methods adapted to provoke hyperæmia of the brain, as, for example, by placing the fainting person in such a position that the head is lower than the body, or the method of Benham and Notley, who have shown that while the plunging of all the body except the head into a hot bath will produce a tendency to faintness, this is soon averted if the head also is plunged into the hot water, and that hence the application of heat to the head will avert an attack of syncope.[1]

We have to recognise, therefore, that not every interruption of consciousness constitutes normal sleep; besides this interruption and the presence of cerebral anæmia, it is also necessary that there should be active nutrition of the tissues, and apparently also active blood formation, for it is asserted that the more considerable the number of red blood corpuscles, and the stronger and more resistant they are, the less necessary is sleep (Byford, Durham, etc.).

[1] *Lancet*, March 14th and 21st, 1885.

Excessive Sleep.—We must now turn from the consideration of insomnia to those morbid states which are characterised by excess of sleep. I have already pointed out that persons with feebly developed consciousness sleep much, because a feeble consciousness is easily and quickly fatigued. This is the case with children, savages, cretins, and people of inferior intelligence, who sleep much and fall asleep as soon as they have no occupation. There can be no doubt that the development of consciousness is always more or less parallel with that of individuality, of the internal *ego*, so that it is not surprising that persons of strong will and clearly marked individuality sleep relatively little.

To realise the feeble development of individuality in cretins, for example, it is sufficient to examine the expression on their faces, which by no means necessarily corresponds with that of the feeling which animates them, and is sometimes even in opposition to it, so that they may smile when they are angry or sad. In little children, also, one may sometimes observe, though to a slighter extent, the same lack of harmony between expression and feeling. Claye Shaw has observed the same peculiarity in the insane.[1]

If we realise that persons with feeble consciousness need much sleep, we may understand how it is that the same tendency is observed in many diseases, and that the anæmic are somnolent, as are the subjects of leucæmia and of the strange disease known as myxœdema, for in all these morbid states consciousness is weakened, in the anæmic and leucæmic on account of the abnormal condition of the blood, and

[1] *St. Bartholomew's Hospital Reports*, 1874, vol. x.

in the myxœdematous on account of the formation all over the surface of the body of a mucous tissue, mucine, which envelops the peripheral nervous apparatus and the nervous channels, stifling them, and isolating them from a large proportion of exterior impressions. At the same time myxœdematous subjects experience an increasing apathy, a growing heaviness of all the mental faculties, and this deadening of the intelligence is so marked that many authorities have regarded this disease as a sporadic idiocy—that is to say, a form of idiocy developing in subjects formerly normal. The character of these patients is also wholly modified, and consequently their consciousness, and they become more and more somnolent. It is not necessary to point out that the diminution of sensibility to impressions from the external world found in these patients, must act on the psychic life as well as on the nutrition of the organism generally.

The immense importance of the amount of the impressions coming from the surrounding world to maintain consciousness in a state of wakefulness, is shown by Strümpell's famous case of general anæsthesia. In this case a shoemaker's assistant, sixteen years of age, who was blind in one eye and deaf in one ear, became anæsthetic over the entire surface of the body, the sensibility of the skin being thus entirely abolished. It was only necessary to close his healthy (right) eye and stop his normal (left) ear, and in two or three minutes he would fall into a deep sleep. Receiving no impressions from without, and at the same time possessing but a poor and limited psychic world, he could not find within himself sufficient images and ideas to furnish con-

sciousness with the materials necessary to maintain its activity.[1]

We may understand the importance of sensations for the development of consciousness, and of the nervous system generally, by recalling for example the investigations of Lombroso, which have proved that the more refined and developed the senses are, the more intelligent is the subject.[2] The same fact is illustrated by Itard's observations, which show that deaf-mutes never attain the same degree of intelligence as wholly normal subjects, that their feelings are always more sluggish, and, what is more interesting, that the enfeeblement produced in deaf-mutes by the absence of sensations of hearing and of speech itself, is also reflected on their normal organs of sense, that they are less sensible to various painful impressions, and easily support such painful operations as the extirpation of ingrowing toe-nails, the setting of broken bones, etc.

From the present point of view this may easily be understood, for where consciousness is feebly developed, painful sensations must be feebly felt. It is less easy to explain why, with this general enfeeblement we also observe a much slighter impressionability to the influence of drugs; it has, however, been found that deaf-mutes, for instance, do not react at all to ordinary doses of the strongest purgatives. Other observations seem to show that

[1] Pflüger's *Archiv. f. die Gesammte Physiologie*, 1887, Bd. xv.; also Adolf Strümpell, *Ein Beitrag zur Theorie des Schlafes*. Other similar cases have been recorded by Heinrich Witte (Inaug. Diss., Leipzig, 1894), and are summarised in *Journal of Mental Science*, April 1896.

[2] Lombroso e Ferrero, *La Donna Delinquente*, 1894 (French edition, *La Femme Criminelle et la Prostituée*, 1896; abridged English edition, *The Female Offender*, 1896).

the blind also show a certain enfeeblement of the central nervous system, and, parallel with this diminution of conscious life, a slower metabolism. This slackening of nutritive changes is so considerable that a blind animal loses much less weight by starvation than a seeing animal.

It is scarcely necessary to add that both deaf-mutes and the blind have less need of sleep than normal persons, but both this question and that of metabolism in those deprived of the various sense-organs still need careful and detailed investigation to be definitely settled. In any case, however, experiments on animals left without food have shown that during the process of starvation they lose much more of their weight by day than by night; and this difference has been observed even in those cases in which the subjects of the experiment were placed, both by day and by night, in darkness, in tin boxes with lids of the same metal. In these experiments the boxes were so arranged that the animals submitted to starvation were placed in such a way that they could not move to any great extent, and the subjects chosen for experiment were rabbits, that is to say animals accustomed to be awake during the night; therefore the difference in loss of weight must be due to the greater number of exterior impressions received during the day, the noisy occupations of daily life reaching the animals enclosed in their tin boxes. Sleep thus played no part in these experiments (Wjatcheslaw and Manacéïne).

It is also recognised that prolonged starvation induces more or less marked sleepiness, and we thus reach the conclusion that the tendency to sleep is increased and reinforced in all disorders in which

there is a more or less marked enfeeblement of consciousness; it is a matter of indifference whether the diminution of consciousness depends on an abnormal composition of the blood (anæmia or leucæmia), the abolition of sensibility, the destruction of the organs of sense, or the general exhaustion of the animal organism in consequence of grave disease or insufficient nutrition.

Hibernation and Prolonged Sleep.—The tendency to sleep may be so strong in some cases that both animals and men may sleep for many days, weeks, and even months. Among animals we meet with winter-sleep and with summer-sleep. Winter-sleep, or hibernation, is observed in mammals, such as bats, marmots, hedgehogs, etc., which fall asleep when the cold weather begins and awake on the return of spring. The animal loses its heat to a very marked extent, although the temperature of its body always remains rather higher than that of the surrounding air. Metabolism greatly diminishes during winter sleep, and at the same time there is a slackening of the respiration and of the cardiac respiration, as well as a kind of muscular immobility, a sort of rigidity. When hibernating animals are brought into a warm room they awake, and their temperature rapidly rises (Saissy, Horwath, Quinke, etc.).

The phenomenon of hibernation has frequently been investigated, but its essential nature remains unexplained. Liébault and Forel regard it as an autohypnosis. Blandet considers that it is a vestige from a very remote epoch when the winters on our planet were so severe that animals involuntarily fell asleep during the winter, because that was their only chance of surviving the winter cold, but that as the

climate gradually grew milder the winter sleep became rarer, and will finally disappear from the surface of the globe.

It must be observed that among marmots, and probably also among hedgehogs, there are individual differences in hibernation, some individuals sleeping longer and more deeply than others; among marmots we may even find some which do not hibernate at all, at all events in captivity. This difference is evidently due to a difference in neuro-cerebral organisation. We must conclude, therefore, that among marmots cerebral consciousness varies, and that some individuals are what we may call strong-minded.

Summer-sleep is observed in hot countries among cold-blooded animals who cannot support a very high temperature of the surrounding air (Pflüger). In summer-sleep the muscular system is in a peculiar state resembling rigidity. So far as I am aware, no experiments have yet been made on metabolism in animals in the state of summer-sleep.

Before proceeding to the question of prolonged sleep in human beings, we may pause to consider how it is that such opposed influences as the harsh cold of a severe winter and the stifling heat of a tropical summer can cause the same result of exaggerated somnolence and deep sleep. If the somniferous influence of winter was manifested exclusively on warm-blooded animals and the somniferous influence of heat exclusively on cold-blooded animals there would be little difficulty, for we might then suppose that the influence of cold and heat depends on special qualities of the organisation of warm-blooded animals on one side and cold-blooded animals on the other. The question cannot, however, be so simply answered,

and every one has probably had occasion to verify on himself the somniferous action of cold as well as of heat. Strictly speaking, however, there is here no contradiction, for both cold and heat act in the same way by provoking a dilatation of the peripheral vessels of the skin, and consequently an afflux of blood to these vessels. Any one may recognise the truth of this statement by recalling that the most uncovered and least protected parts of the body, the face and hands, redden under the influence of heat as well as of severe cold. It is obvious that if the surface vessels dilate there will be less flow of blood to the brain, and consequently more or less somnolence, resulting from the cerebral anæmia thus produced; diminution of blood in the brain thus weakening consciousness and rendering it inactive.

Narcolepsy.—We must now turn to the question of prolonged and abnormal sleep in the human subject, that is to narcolepsy. Such sleep for the most part only occurs in isolated cases, but it is sometimes found in various countries as an endemic disease, being there known as the sleeping sickness, hypnosia (Dangain), and by various other names. It seems to have been first observed by Winterbottom, in 1819, as being very common among the slaves in the Bay of Benin, on the west coast of Africa; in 1840, Clark found it common in Sierra Leone among the free Africans; and by other observers it has been found on the Niger, in the Antilles, etc. Its endemic area extends from Senegal to the Congo, in the Sierra Leone district and the *Hinterland*, especially in the valley of the Congo; only negroes are affected, and there are more cases inland than on the coast. According to various English medical observers

(Mason, Hood, Fergusson, Gore, Forbes), this strange pathological sleep usually manifests itself after prolonged and fatiguing work which has exhausted the subject's strength. The result, which is the same whether the work was physical or mental, is death. It has been observed that this prolonged sleep is very often met with in persons of feeble and irregular mental activity, of undeveloped consciousness. It is first manifested by enlarged lymphatic glands (which the natives are accustomed to treat by excision) and persistent drooping of the eyelids. At first the subjects, who are usually young adult males, can be roused, but the periods of sleep become longer and more frequent, until at last sleep is almost continuous, food is refused, and emaciation and exhaustion lead to death, in the course of weeks or months. The mental faculties often seem to clear up just before final extinction. In fatal cases of African narcolepsy, Fergusson found that the brain was anæmic and unusually firm; and inflammation of the brain membranes is also found.[1]

In Europe narcolepsy usually consists of an irresistible tendency to sleep, sometimes developing in consequence of a considerable loss of blood, of a painful emotion, of excessive fatigue, etc.; but sometimes also without any traceable cause. An abnormal sleep of this kind may last for several days, weeks, or even months without intermission. It is for the most part impossible to awaken such subjects, and even if awakened they soon fall asleep again. Metabolism is evidently decreased during narcolepsy, as during the hibernation of animals; this conclusion is war-

[1] See, for example, C. Forbes, "The Sleeping Sickness of West Africa," *Lancet*, 12th May *1894*.

ranted by the fact that individuals who are plunged into this prolonged and pathological sleep need neither food nor drink, although if any liquid nourishment is poured into the mouth they easily swallow it. This decreased metabolism is also shown by observations at Berlin on a woman who slept without waking for forty days; during this abnormal sleep there was a considerable decrease in the daily amount of urea secreted (falling to a third of the normal amount), the blood was notably thickened, and the quantity of hæmoglobin was relatively greater than normal.

Sensibility in all its forms is usually weakened during such a sleep. The subjects almost never dream, and on awaking cannot recall any sensations experienced during sleep; consciousness was interrupted at the moment they fell asleep, and they cannot understand that they have slept for weeks or months. The face during this strange sleep is usually pale, and an ophthalmoscopic observation made in London in 1891 of the eyes of a man who had slept uninterruptedly for seventeen days showed that all the vessels of the retinæ, both veins and arteries, were excessively contracted (Brudenell Carter).

Most of these pathological sleepers exhibit a more or less pronounced cataleptic condition which imparts a certain rigidity to their muscles, so that in this respect the prolonged sleep of human subjects presents a complete resemblance to the winter-sleep of animals.

With these attacks of prolonged pathological sleep we may also group the briefer attacks frequently considered to be of an epileptic character, which Féré calls *paroxysmal* sleep, and which consist in more or less

fleeting interruptions of consciousness, manifested by the subject in the midst of the most diverse occupations, even while talking, and then the phrase may be interrupted, perhaps in the middle of a word, which is completed when the attack is over, without any knowledge of what has happened. It is of special interest to observe that such interruption of conscious activity in the victims of epileptic *petit mal* is only observed when the patient is occupied in some work which demands the active participation of consciousness; if, on the contrary, the attack comes on when the patient is engaged in some habitual work of routine which can be accomplished without the aid of consciousness, the attack fails to interrupt the work. Thus it has been observed that violinists continue to play in the orchestra, without making mistakes or getting out of time, although consciousness is interrupted by an attack of epileptic *petit mal* (Ribot). But such patients are never able to carry on a conversation or continue a narrative when consciousness is temporarily annihilated by *petit mal*. Such a fact shows clearly that there is an intimate and indissoluble connection between consciousness and human speech, and as human speech cannot be exercised without consciousness, the epileptic attack always interrupts speech.

Paroxysmal sleep usually occurs in disturbed states of the nutrition of the organism generally, such as in various circulatory and digestive disturbances, in diseases of the heart and liver, in hysteria and neurasthenia as well as in epilepsy. The patient is seized suddenly as if by an epileptic attack and remains in a deep stupor from which no stimulus will rouse him. This may happen while he is

at work, at table, when walking, etc. Lasègue reports a case in which a young waiter suddenly fell asleep while serving and stood sleeping for a minute with the glass in his hand, after which he awoke and continued serving. The sleep often develops before the patient has time to sit down, but in other cases he feels the ordinary premonitory symptoms of sleep. The sleep lasts usually for a few minutes, sometimes half-an-hour or more. The attacks vary in frequency, but they tend to become more frequent, once a month, once a week, once a day, and in a case reported by Gélineau there were as many as two hundred attacks a day. The attacks may be brought on in a variety of ways, by walking or other muscular exertion, by emotion, by sexual excitement. Some patients are especially sensitive during a thunder-storm. The sleep exhibits all the characteristics of normal sleep in an intense degree. The extremities are relaxed, the sensibility so diminished that neither shouting nor mechanical stimulation will arouse the subject. The respiration and pulse are both slackened, and the pupils are usually dilated, not even contracting to strong sunlight. There are no dreams. As a rule these subjects sleep well at night. They often belong to nervous families, and the attacks sometimes alternate with slight epileptic attacks, whence this sleep has been called the epileptoid sleep, and by Mendel is considered a form of masked epilepsy. I have had occasion to observe two such cases; both patients were illiterate and of slow intellect. One of them, a housemaid of nineteen years of age, was a very sound sleeper at night, and in the daytime one could never be sure of her *remaining* awake. I have seen her going to sleep in

the very act of announcing a visitor and in bringing in a tray with cups full of coffee. The other was a woman of fifty, who was a nurse till in one of her sleeping paroxysms she dropped the infant on the floor and nearly killed him. In both the pulse was remarkably slow: in the girl it varied between 50 and 70 beats when awake; in the woman of fifty between 40 and 60. Every excitement caused, instead of acceleration, a retardation of the heart-beats, the pulse falling to 35 in the woman and to 40 in the girl.

To the same group belongs catalepsy, of which an outbreak raged endemically for several years at Billinghausen, near Würzburg, and was described by Vogt. Half the inhabitants suffered from attacks of catalepsy, only lasting for a few minutes, during which the face became intensely pale, the limbs motionless, consciousness, if not altogether abolished, much obscured, and speech embarrassed. The attacks were liable to occur at any moment and fixed the patient in the position in which they caught him. All those who were attacked showed a very feeble physical and intellectual development. The disease was transmitted by heredity, not immediately by parents to children, but atavistically, by skipping a generation, from grandparents to grandchildren. Those attacked by this cataleptic disorder were commonly called *die Starren* (rigid).

It may not be unnecessary to remark here that serious derangement and enfeeblement of consciousness always affects the muscular system; thus idiots are characterised by more or less awkwardness of movement (Ireland), and Maudsley remarks that a skilful physician can diagnose idiocy by the patient's

movements alone, adding that he can himself diagnose other mental affections by the movements. Various authors (Bruno Meyer) have also remarked that gross and vulgar psychic qualities are always reflected in the movements, and that thus a face with regular and beautiful features may become disagreeable and repulsive when it expresses a brutal disposition, while ugly and irregular features may charm us if the play of their expression reveals a beautiful soul. So that if attacks of epileptic *petit mal* do not disturb even the delicate movements executed by the violinist, it can only be because they last too short a time to interfere seriously with consciousness.

It is to be specially noted with reference to narcolepsy or pathological sleep, that those persons who become victims of this disorder always belong either to the lower and least developed classes of the community, or else to families which show hereditary traces of nervous or mental disease. This is natural, for in order for narcolepsy to declare itself a very weak and unstable condition of consciousness is required.

Very often the victims of this disorder present a series of narcoleptic attacks, repeated more or less often, and with a marked tendency to aggravation at every repetition. Before the attacks the patients sometimes say themselves that they feel weak and stupid, as in the case described by Ward Cousins. Sometimes narcolepsy develops after a violent emotion (as in the cases described by Barker and Imbert). Thus cases may be found in medical literature of narcolepsy developed as a result of the grief occasioned by the loss of a beloved person, or after a loss of fortune. There is special interest in the case of Napoleon

after the battle of Aspern, the first battle which the Emperor lost after seventeen victories. He was so overcome by this reverse that he experienced invincible somnolence, and slept for thirty-six hours without awakening, so that his suite feared for his life. It is known that he usually slept very little, for only four or five hours, so that it can be easily understood that the loss of this battle must for the time have greatly overcome his powerful consciousness.

In other cases narcolepsy appears after great physical fatigue, as, for example, after prolonged dancing (Haller). Sergius Botkine, the distinguished physician, has told me of three cases of narcolepsy which he observed at St. Petersburg. Two of these patients were young girls, one of whom went to sleep after a ball and could not be awakened; the other was successfully treated by electricity, but recovery was only temporary, the attacks of narcolepsy appearing again after a time, and recurring at frequent intervals. The third patient was an old woman, whose case resembled that of the mathematician Moivre, already mentioned. In the sixteenth century a case of narcolepsy was recorded, developing as the result of a long vigil, and terminated by death. In another case, a young girl having lost her way in a forest, and becoming greatly fatigued in finding it again, on reaching home fell into a strange sleep from which she could not be awakened.

In those cases of narcolepsy in which sleep is so deep as to constitute a danger to life, respiration and cardiac pulsation diminish to such an extent that on superficial examination they cannot be detected, as happened in a case described by Schaber. The patient was a soldier who suffered from narcolepsy from the

age of twelve; at the age of twenty-two he had an attack which lasted seven days and from which he nearly died, but was saved by the application of heat, massage, and artificial respiration. A century ago such attacks terminated in death more often than to-day; for at that time it was usual to bleed such patients as a matter of routine; their condition was thus aggravated and death more or less accelerated.

To give a clear notion of this singular disease I will describe a typical case. The patient was forty-three years of age when he began to show signs of mental disorder, with ideas of persecution. From this he recovered in time, but all intellectual work had become impossible; even reading fatigued him immediately, and he slept badly. He now began to complain of heaviness in the head; he only replied to questions by monosyllables; and before long he fell into a sleep which lasted two hundred and twenty-one days. He was treated by electricity, and beneath its influence his pulse quickened, but notwithstanding the treatment the attacks became more and more frequent, though many of them only lasted for four days. Besides electricity, douches were tried, but they were without effect. In the intervals of attacks the patient would quietly take a book and continue reading from the point where he had been interrupted by the attack, even although the interruption had lasted for a month or six weeks. Before his last attack of narcolepsy, which lasted longer than any of the others and terminated in death, the patient had undergone an exceptional degree of mental work, having occupied himself with physics and physiology. This final attack lasted four hundred and sixty-five days. At the autopsy a centre of necrosis was found

in the brain. During the last eight years he had spent 1698 days, or more than four and a half years, in sleep. It should be stated that the patient belonged to a family in which there was a hereditary predisposition to mental disease.

A case of narcolepsy, which may be regarded as typical, was carefully studied by Semelaigne at Paris. The patient was a man of fifty-six, who first slept for seven months without interruption. This attack was succeeded by alternating periods of sleeping and waking; the longest narcoleptic attack, the thirty-ninth, lasting for fifteen months. No signs of mental disorder were observed. During the attacks he was motionless and absolutely mute; the eyelids were closed and the eyes turned inwards: the expression was calm and emotionless. The pulse was soft; pulse-rate, 60. Respiration normal, and temperature C. 36.7. He died after a continuous attack of over three months. The autopsy revealed adhesions of the membranes, and considerable wasting of the convolutions, especially in the motor zone.[1]

[1] *Annales Méd. Psych.*, January 1885. Various cases of prolonged natural sleep will be found in the *Dict. ency. des sci. méd.*, art. "Sommeil," pp. 299 *et seq.* At the Rochefort Hospital there was recently a patient styled by the medical press "a true sleeper." During three months the sleeper, whose name is Victorine Doirat, was carefully watched, therefore shamming was out of the question. She was admitted into the hospital on January 31st, 1897. During a month she had been plunged more or less in sleep, remaining in a cataleptic condition for five consecutive days without eating or drinking, or satisfying any of the wants of Nature. The day on which she was taken to the hospital she had an attack of somnambulism, and frightened her neighbours by going to them moving like an automaton with shut eyes. The morning after her admission the *chef de service* going his rounds found her asleep. By means of stimulants and suggestions she was awakened and induced to take some soup and drink some milk. An hour afterwards she fell into cataleptic sleep. This condition con-

In the first case described electricity seemed the surest method of awakening the patient, as also it has been found in cases described by Elze, Botkine, and Hufeland. And as we have already seen that in insomnia, that is to say in a condition exactly opposed to narcolepsy, electricity has also yielded good results, it is evident that in both cases it acts, so to say, as a passive gymnastics of the blood-vessels, improving the tone of the vessel walls, and thus probably at once averting both semi-paralytic dilatation and spasmodic contraction of the cerebral vessels.

This explanation of the salutary influence of electricity in narcolepsy is justified by the well-established fact that massage of the body has often produced good effects in narcolepsy. I have already referred to Schaber's case, in which a young man of twenty-two was aroused from narcolepsy and saved from death by energetic massage of the whole body. A case also has been reported in England of a man who during fifteen years manifested a marked tendency to sleep, and during the last two years suffered from genuine attacks of narcolepsy. These attacks came on suddenly, even in the midst of interesting

tinued, interrupted by intervals of waking, which were very variable. Sometimes they occurred several times in a day; at others after two or three days' sleep. The waking intervals never exceeded two minutes. She opened her eyes and asked for food; if not immediately satisfied she fell asleep. In order to oblige her to take nourishment, she was awakened by stimulating the median and ulnar nerves, but her eyes closed again almost as soon as they opened. At twenty years of age her excited condition obliged her family to put her in an asylum. At twenty-eight she married a deaf and dumb man. Her appearance was healthy. The eyelids constantly trembled, the body was rigid, and the limbs remained for several hours in the position in which they were placed. (*Lancet*, 8th May 1897.)

occupations, as when he was playing at cards. Once the attack came on after he had rung at the door of a house and while he was still waiting for it to be opened. No treatment proved effectual until Morrison employed massage, when the narcolepsy disappeared completely.[1]

In the presence of these facts we may trace an analogy between narcolepsy in the human subject and hibernation in animals, for, according to Valentin's observations, the surest method of arousing animals from their winter-sleep is electricity. We have seen, also, that metabolism is decreased both in hibernation and narcolepsy, that respiration and heart-action are slackened, the temperature markedly lowered, and that in both cases the muscles may exhibit more or less accentuated cataleptic phenomena. In narcolepsy there is a great diminution in the need for food and drink, if not its complete abolition, so that in this respect, also, pathological human sleep resembles the winter-sleep of animals. Finally, it may be noted that hibernation only occurs in animals which by the organisation of their nervous system are lowly placed in the zoological scale, and that among human subjects narcolepsy is met in individuals belonging to families with a hereditary predisposition to nervous and mental disease, or who are hysterical, or unintelligent—that is to say, in persons whose consciousness is altered by disease, or undeveloped, and consequently feeble.

It has been observed that attacks of various spasmodic and convulsive disorders often appear during sleep; thus convulsions usually occur in

[1] Alex. Morrison, "Somnolence cured by Massage," *Practitioner*, April 1889.

children at night during sleep. It is so, also, with epilepsy, which sometimes occurs only during sleep, and the paroxysms of asthma; spasm of the glottis (as in laryngismus stridulus and catarrhal croup) is most easily started during sleep. On the other hand, it is recognised that both little children and cretins show a marked tendency to convulsive disorders (Maudsley), and, as Weiss justly remarks, this tendency can only be explained by the undeveloped state of the nervous system, and as all exercise of will and inhibition of reflex movement are impossible in the absence of consciousness, we may conclude that this tendency is connected with a feeble development of consciousness. Anstie showed that the action of hypnotic and narcotic drugs increased reflex activity, and, as has already been pointed out, narcotics to some extent resemble normal sleep in their action. We may conclude, therefore, that convulsive disorders develop more easily the weaker consciousness is, and that a strong and developed consciousness is refractory to such disorders.

This is supported by Mackenzie's observations on chorea, or St. Vitus's dance, which have shown that this convulsive disorder occurs much more frequently in the lower social classes, among whom cerebral activity is not generally developed to a high degree. According to these observations, in 100 cases of chorea, only 2.79 occur among the upper classes, and 26.74 among the middle classes, while not less than 70.46 are found among the lower classes. It is believed that these numbers really represent the frequency with which chorea occurs in different *classes of* society. It must of course be remembered

that the lower and middle classes largely predominate in number over the upper classes. Still the figures seem significant.[1]

Since all enfeeblement and interruption of conscious cerebral activity reinforces the reflex phenomena in the organism, we may, for instance, understand why purely reflex movement like a cough becomes specially troublesome at night, and torments us precisely when we are about to fall asleep. It must be added, however, that convulsive disorders are not always due to purely reflex movements, some being caused by loss of the equilibrium between antagonistic muscles, such equilibrium being necessary to assure the regular and normal activity of the muscular system. Thus various spasmodic affections, like *paralysis agitans*, chorea, and other spasmodic movements of special muscles, disappear during deep sleep. In the same way, when such reflex convulsions (epilepsy, eclampsia, etc.) occur in the waking state, they are always accompanied by loss of consciousness, and there is an approach to the automatic state.

Automatism in psychology is that state in which an individual accomplishes mechanically different muscular acts without the participation of consciousness.[2] In a very pronounced and complete form it is sometimes observed after injury to the head, but it may also be called forth by different pathological affections of the central nervous system. Thus the subject may not understand or be able to answer any

[1] Stephen Mackenzie, "Report on Chorea," *British Medical Journal*, 26th February 1887.

[2] The precise definition and classification of automatic acts are, however, still somewhat obscure. See C. Richet, art. "Automatisme," *Dict. de Physiologie*, 1896.

question; the organ of hearing remains intact, and the subject hears all that is said, but in reply he can only repeat mechanically what he has heard, over and over again, at each repetition cutting the phrase shorter and omitting final syllables until the whole has disappeared. This phenomenon is called echolalie.

In the category of automatic acts we may include the different habitual movements reproduced by persons during severe illness; thus a glass-blower, when unconscious from illness, began to blow vigorously as soon as the spoon or cup containing medicine touched his lips, and Hughlings Jackson mentions a militia sergeant who curled and twisted his moustache with "remarkable regularity and grace" during the coma of cerebral hæmorrhage. In the last moments of life our habitual movements may thus reveal what we were.

In place of quoting further examples I will describe a single case reported by Mesnet.[1] At the battle of Bazeilles, in 1870, a soldier was wounded in the region of the left parietal bone, and was compelled to pass two years in hospital on account of right-sided paralysis, which at length disappeared almost completely, and the patient, while still under observation himself, was able to act as an attendant in the hospital. He was subject to attacks of complete interruption of consciousness, during which he could see nothing, not even the brightest light, and hear nothing; taste and smell were also absent, touch alone remaining; thus as he walked he would knock

[1] E. Mesnet, "De l'automatisme de la Mémoire et du Souvenir dans le Somnambulisme pathologique," *L'Union Médicale*, July 1874; also summarised in *Journ. Mental Science*, Oct. 1875.

against the objects in his path, but by touch was able to find his way. He felt no pain, and could be pinched or pricked without knowing it. During these attacks the patient was transformed into a complete automaton. He repeated mechanically all the movements and actions of his normal life, walked, rolled cigarettes, lighted them, smoked them, but without observing whether it was wool or sawdust that he smoked in place of tobacco. He ate and drank, but he would swallow the most nauseous medicine without realising that it was not wine. If a stick was presented to him in a manner that recalled a gun to him, he manipulated it accordingly, at the same time recalling scenes he had lived through during the war and pronouncing the appropriate words. These attacks appeared at intervals of from fifteen to twenty days, without fixed periodicity, and lasted for a day or two. During the intermediate days his state was entirely normal, and he was unable to recall what had happened during his attacks of automatism. We shall have to study such cases when dealing with dual personality.

Some light is thrown on consciousness by those cases in which it is abolished temporarily, whether by a ball in the brain or by depression of the skull. At the battle of the Nile a British captain while giving an order from the quarter-deck received a shot on the skull, which drove inwards a portion of the bone and immediately deprived him of consciousness. He was taken home, and for no less than fifteen months he lay in Greenwich Hospital deprived of sense and speech. An operation was then performed on the head which immediately restored him to consciousness; whereupon he rose in his bed and completed

the interrupted command.[1] Many similar cases are to be found in clinical records, and they serve to show that with the interruption of consciousness associated movements are also interrupted and may long remain in, as it were, a latent state.

Consciousness and Attention.—We have seen that in an arrest of consciousness, such as narcolepsy, however long it lasts, the subject on awakening resumes his conscious life at the point where it was arrested by the pathological sleep. We have also seen that consciousness alone among our psycho-neural aptitudes needs complete repose, and that when divided, as in mental disease, it ceases to be fatigued, and sleep becomes less necessary. The continuous activity of consciousness, in other words, with its accompanying activity of the circulation, of metabolism, etc., involves the simultaneous exhaustion of its anatomical elements and a necessary need of repose, of sleep. We can thus understand why absolute insomnia is even more injurious than complete absence of food, and also why a superficial and often interrupted sleep exerts a pernicious action on the organism.

The continuous watchfulness of consciousness is shown by those cases in which a man, absorbed in thought or in his work, neither hears the clock

[1] Forbes Winslow, *Obscure Diseases of the Brain and Mind*, p. 374. Winslow quotes from Oliver the case, which occurred in the seventeenth century, of a farm labourer at Timsbury, near Bath, who slept continuously for seventeen weeks, and then awoke "perfectly unconscious that he had slept more than *one* night. Nothing could make him believe that he had been asleep for so lengthened a period, until, upon going into the fields, he saw crops of barley and oats ready for the sickle, which he remembered were only sown when he last visited them." Such occurrences no doubt lay at the foundation of the legends concerning persons who slept for a century or more, without realising the *lapse of time.*

striking the hours nor the remarks which are made to him; but afterwards, tearing himself away from his absorbing occupation, he hears retrospectively, so to speak, the sounds which have disappeared in space but are preserved in his consciousness. Henle has shown that such reproduction of long vanished sounds, not perceived immediately, may even make itself felt on the following day, twenty-four hours afterwards.

At the first glance it seems that such cases show chiefly the possibility of perception without consciousness, but this is not accurate. It is sufficient to analyse such facts carefully—and we may all do so upon ourselves—to be convinced that it is not correct to say that we do not hear the sound of the clock, or the melody played, or the words addressed to us, for we hear them all; only we do not stop to analyse these sounds, we put them aside, as it were, until we have completed the work in hand. In proof of this it may be recalled that whenever in the course of absorbing work it is necessary to hear the stroke of the clock, or other sounds, we do hear them in spite of our absorption, and at once interrupt our work. This often happens to those who are attending to the sick. To keep off sleep in the silence of the sick chamber we perhaps take up an interesting book; but we do not become so absorbed in it that we cannot at the same time be attentive to the movements of the patient, to his respiration, his moans, and however attractive the book may be we remember the hour when the medicine must be administered.

Such facts show that consciousness is capable of perceiving different sensations simultaneously, but

is able to leave the detailed analysis of these sensations to a favourable moment. Those impressions which, for one reason or another, have not reached consciousness are lost absolutely and for ever. We must, therefore, suppose that consciousness can concentrate its energy on one part of its domain, while not completely abandoning the other parts, though here its activity is inhibited and limited to the most elementary acts of perception, to the exclusion of all the higher psychic functions of association, judgment, etc.

It is easy to understand that such artificial inhibition is only possible at the price of considerable tension, of an energetic discipline of consciousness, so that persons whose consciousness is feebly developed are powerless to concentrate their attention on anything for any length of time. It is, for instance, found that children the younger they are experience the greater difficulty in fixing their attention. The same is true of savages; thus MacCauley narrates that a Seminole Indian of Florida replied to his first questions concerning the language and life of his people every morning and afternoon for a fortnight through the severe heat of an attic room. "I could see how much I wearied him," remarks MacCauley; "often I found by his answers that his brain was, to a degree, paralysed by the long-continued tension to which it was subjected. But the only sign of weakness he made was on one day about noon, when, after many, to me, vexatious failures to draw from him certain translations into his own language of phrases containing verbs illustrating variations of mood, time, number, etc., he said to me, '*Doctor*, how long you want me to tell you

Indian language?' 'Why,' I replied, 'are you tired, Billy?' 'No,' he answered, 'a littly. Me think me tell you all. Me don't know English language. Bum-by you come, next winter, me tell you all. Me go to school. Me learn. Me go hunt deer tomollow.'"[1]

The expenditure of cerebral energy involved in the concentration of attention is also illustrated by the fact that idiots are often powerless to fix their attention; and that many persons in consequence of illness fall victims of a pathological enfeeblement of the central nervous system.

Differences in the power of concentrating attention are also observed among animals. I may refer to the case, described by Darwin, of a man who taught tricks to monkeys, and wishing to purchase a few monkeys for this purpose, offered to pay double the price asked if he might be allowed to keep several of them for some days before making his choice. On being asked the reason for this choice, he explained that he could thus decide which would suit him best, by observing how they followed the different tricks performed before them. Those most able to fix attention upon the tricks were always best able to learn, while those only capable of fleeting attention would prove more or less refractory to all teaching.

The Influence of Monotony.—All monotony of thought or feeling is a source of fatigue, and if

[1] MacCauley, "Seminole Indians of Florida," *Fifth Annual Report Bureau of Ethnology*, 1883-84, p. 493. It may be added that perhaps even a European, not accustomed to mental exertion, after answering grammatical questions in an unfamiliar language seven hours daily for a fortnight might experience some fatigue of consciousness.

lasting for a considerable time may have grave results, since, as we have seen, concentration of consciousness on a single series of phenomena may cause limitation of activity in other fields.

Psychological experiments in the laboratory have shown how speedily monotonous work produces fatigue.[1] Clinical evidence had already reached the same result. Crichton Browne expresses the belief that acute dementia is specially developed under the influence of emotional and intellectual monotony. He calls attention to the fact that the English regiments stationed on the west coast of Africa, forced to lead an extremely monotonous life, furnish a much larger quota of mental diseases than the regiments situated in other localities where life is more varied. He attributes, also, the frequent development of insanity in young criminals to the monotonous life of prisons and reformatories.

It is well known that when we concentrate our attention on a monotonous sound or on some uniform sensation, sleep speedily results; thus Boerhaave made his patients drowsy by making them listen to the sound of drops of water falling upon a metallic surface. Russian nobles, in the good old days, had another method for sending themselves to sleep; they ordered their servants to scratch their heels for a long time. The mothers of Corea, A. H. Savage-Landor tells us, send their infants to sleep by scraping them gently on the abdomen, a method which is always successful even with the most restless baby. There are people who count in order to send them-

[1] See, for instance, Kraepelin's *Psychologische Arbeiten* ("Ueber Ermüdung und Erholung," von W. H. R. Rivers and E. Kraepelin), *Bd. i., Heft* 4, 1896.

selves to sleep; ladies have their hair brushed; monotonous lullabies are sung to children; but all these methods may be reduced to the effort to fatigue consciousness by monotony, and thus to induce sleep.

The manipulations of the hypnotist in the same way tend to fatigue consciousness by the monotony of visual, auditory, or tactile sensations, and so to provoke its temporary arrest. No doubt the hypnotiser succeeds best in those subjects who are not possessed of a powerful consciousness, but are somewhat lowly placed in the intellectual scale.[1] It is not surprising that if such subjects are often submitted to hypnosis they may become habituated to hypnotic arrests of consciousness, so that at length they may fall into the hypnotic state at the mere sight of a bright object, or even when their own hands are placed in a certain position, as Ball found in the case of a lady's maid upon whom her too inquisitive mistress had made hypnotic experiments. Under the influence of repeated hypnosis the consciousness may become more and more enfeebled, a risk to which those who use hypnotism have now become fully alive; it has also been found that convulsions occur in those subjects who are liable to them; Mesmer went so far as to assert that no benefit was obtainable unless hysterical convulsions were produced. It has even been asserted that insanity may result from hypnosis. The number of persons sensitive to hypnosis at any given epoch

[1] At the same time, as Forel and others have pointed out, the brain must be sound to fall under the influence of hypnosis; it is difficult, and often impossible, to produce hypnosis in the insane or even the hysterical.

might thus be said to be in inverse ratio to the general mental development. Perhaps there has been an improvement in this respect during the last eighty years, for in 1815 Matthei wrote that only one in fifty persons was refractory to mesmerism, while Hansen recently stated at St. Petersburg that only three in ten fall under its influence; as, however, the figures obtained by various experimenters widely vary, it is not possible to trust these figures implicitly. If the fact is so we ought to rejoice, for the best state of society is that which counts among its members the largest number of individuals possessing a strongly developed consciousness, and the fewest of those who approach the type of animals in whom the spinal nervous system predominates. The contagious psychic disorders and crimes of crowds, of late studied by Sighele, Le Bon, and Tarde, become less and less possible as consciousness predominates in a community, for what above all favours the propagation of such psychic epidemics is the presence of a considerable number of people with feebly developed consciousness, people of the spinal type; it is such that furnish the condition of development of epidemics of suicides and of all illogical theories and superstitions.

As an example of a psychic epidemic well illustrating this tendency of the nervous system, I may refer to a psychopathic religious epidemic which occurred a few years ago at Kiev, and was studied by Ssikorski.[1] The originator of the movement was insane, and a large number of his followers, chiefly peasants, exhibited nervous symptoms. They were

[1] *Universitelskija Iswjestija*, 1893.

in a state of exaltation, confident that they would not die, and need not work, as God would take care of them. Eighty per cent. of them had sensory illusions, most of them hallucinations of smell, causing them to perceive extremely agreeable odours which they attributed to the propinquity of Heaven, or to the presence of the Holy Ghost. They spoke with tongues, sometimes had complete analgesia with feelings of lightness, as if floating in the air. Some heard the voice of God, or the whispering of the Holy Ghost, and saw heaven open before them. The prevalence of muscular and spinal symptoms was shown by a marked tendency to fall to the earth, to jump and strike themselves on the breast, and by the frequency of convulsions obviously of an hysterical character, while the women would undress themselves and become erotically excited.

With enfeebled consciousness and heightened activity of the reflex system, all the movements are less differentiated and less easy to master. They are apt to extend to other muscular groups; every act becomes complicated by other analogous acts, and there is thus always a tendency to imitation and to the appearance of irresistible impulses. Thus it is found that not only monkeys, but the lower human races, as well as children, the undeveloped and the hysterical, are characterised by a strong impulse to imitate what they see; they are "suggestible." Thus Hugstrem narrates that among the Lapps he often found individuals who imitated every movement as well as the expression of the travellers who talked to them; all these subjects showed a highly-developed reflex system, and every unexpected sensation, such as a sudden sound, caused general convulsions.

Among various races in different parts of the world similar nervous disorders have been found very prevalent. Latah, found among the Javanese and among the Malays generally, has been especially studied.[1] It occupies a place midway between hysteria and epilepsy, and Gilmore Ellis considers that it is very closely related to hypnotism. Attacks are easily excited; even a look or a movement of the head by another person, or the mention of a word like "tiger" or "alligator," is sufficient to start it. The affection is distinctly hereditary, and those affected are mostly women. The subject will repeat everything that is said, and imitate everything that is done before him, so that he may even be made to cause the death of his own child, as in one oft-quoted case in which a sailor tossed up a piece of wood before the ship's cook, who was liable to be attacked by latah and was at the time nursing his baby; the cook imitated the sailor by throwing up the baby, and when at last the wood fell to the ground the baby fell also and was immediately killed. The subject is conscious but powerless. O'Brien, who has described this disorder, gives the following case as typical:— "A Malay woman of respectable position and exceedingly respectable age was introduced to me some time ago as a strong latah subject. I talked to her for at least ten minutes without perceiving anything abnormal in her conduct or conversation. Suddenly her introducer threw off his coat. To my horror my venerable guest sprang to her feet and tore off her gown. My entreaties were too late to prevent her

[1] As by Van Brero, *Allgemeine Zeitschrift für Psychiatrie*, Bd. ii, Heft 5, and W. Gilmore Ellis, *Journal of Mental Science*, January 1897.

continuing the same course with the rest of her garments, and in thirty seconds from her seizure the paroxysm seemed to be over. She kept on calling the instigator of this outrage an abandoned pig, and imploring me to kill him, all the time she was reducing herself to a state of nudity." In the younger women (who are generally not remarkable for chastity), there is during an attack of latah an entire absence of sexual restraint. The Malays consider the affliction to be due to dreams. Van Brero remarks that latah is really simply an exaggeration of the normal character of the Javanese, who possess a mental feebleness which prevents them from becoming independent in thought and action, so that there is always a weak development of individuality.

To illustrate the influence of suggestibility, in the depressed state of consciousness produced by disease, I may refer to a very interesting illustration which occurred at Edinburgh some forty years ago. An infectious febrile disease raged at this time accompanied by delirium; the cases were numerous in the practice of many doctors, but the patients of a certain Dr. A. tended to present a special and peculiar symptom; they exhibited an irresistible impulse to throw themselves out of the window. The fact would probably have remained inexplicable if a certain Professor D., who also manifested this longing to throw himself from the window, had not been one of Dr. A.'s patients. When convalescent he narrated that he had had no tendency to this morbid inclination until he heard Dr. A. in the bedroom telling his friends how he had had a patient who threw himself out of the window in delirium and was

crushed to death on the pavement, and begging them to watch Professor D. carefully lest he should exhibit this impulse. The patient, who was considered insensible, had followed the narration and was much impressed by it. His consciousness, enfeebled by disease, dwelt on the image of the patient throwing himself on to the pavement, and from that moment an ardent desire haunted him to do likewise. Dr. A. had evidently been so impressed by the violent death of the original patient, that wherever he went he urged the utmost care lest other patients should do the same, mostly in presence of the patients, who at once felt a mad desire to throw themselves out of the window. Consequently Dr. A. became more than ever impressed by the danger and talked about it more persistently, without realising that he himself was propagating this psychic epidemic. The only possible explanation of this phenomenon is that the febrile disease, by enfeebling the conscious cerebral life of the patients, brought the reflexes and the spinal nervous system into temporary predominance, so that the patients became as imitative as little children or savages. The weaker and more stupid an individual becomes the more suggestible he is rendered, and the more easily brought under every influence.

Hypnosis and Sleep.—A further illustration may be found in hypnosis. The subject of repeated hypnotisation is inevitably weakened in consciousness, the more so as his consciousness is probably not vigorous to start with, as we have already seen. He may thus be reduced to the same imitative stage as savages, in the same way as the victims of repeated attacks of epilepsy, which is also a temporary arrest

of consciousness, become more and more stupefied and enfeebled, being finally reduced to a state of complete dementia, and the subjects of irresistible impulses which they obey as Dr. A.'s patients attempted to do.

Hypnosis may probably be ranged among the pathological forms of sleep; or, in other words, it may be considered a pathological state of consciousness, for it is an artificial enfeeblement of consciousness produced by monotonous and uniform sensations.[1] During hypnotic sleep, as during hibernation and narcolepsy, we observe a pronounced tendency to cataleptic phenomena in the muscular system, a reinforcement of the reflexes (Haidenhain), and a notable diminution in metabolism. In this respect these states are distinguished from normal sleep, in which there is probably increased metabolism (Durham, Penzoldt, and Fleisher), especially in the cerebral and nervous tissues. For this reason hypnosis cannot replace normal sleep, since the former enfeebles conscious psychic activity and is not favourable to the reconstitution and nutrition of the tissues, and hypnotisation can only be permitted in insomnia in the same sense and in the same degree as any other narcotic, in the hope that it may induce a normal and salutary

[1] The precise relationship of sleep to hypnosis has excited considerable discussion; the very obvious resemblance of hypnosis to sleep is embodied in the name itself chosen by Braid, and both Bernheim and Forel, two of the chief authorities on the subject, consider hypnosis an ordinary sleep, the person who falls asleep spontaneously being in *rapport* with himself, while the hypnotised person is in *rapport* with the hypnotiser. But, as Moll points out, there are various distinctions between sleep and hypnosis, though none of them are of a very fundamental character; for a discussion of the question see his *Hypnotism* (fourth English edition), pp. 208-222.

sleep. Carried out as a mere form of amusement, hypnotism should be regarded as a crime against the individual and the state itself, since by enfeebling consciousness it tends to increase the pathological elements in the community.

Somnambulism.—Hypnotism leads us to the consideration of sleep-walking or somnambulism, which is indeed so nearly related to it that Richet and others have used the same name for both, regarding hypnotism as an artificial somnambulism, and sleep-walking a natural or spontaneous somnambulism. In the first chapter of this book (pp. 26-28) I have referred to the fact that the muscular system does not sleep, and have given various examples of the way in which, under the influence of fatigue, muscular action has continued unconsciously in a state of sleep. We may also often observe at a concert or a lecture that persons will fall asleep while still holding their eye-glass, fan, or other object in the hands. Such being the case, the action of somnambulists ought not to surprise us, for the only difference between them and normal subjects is that while the latter continue to perform during sleep the action they were engaged in before sleeping, the former go peacefully to bed, and when asleep rise and execute automatically all sorts of muscular acts without awakening, and consequently without consciousness.

There has been much discussion and difference of opinion as to the condition of the various sense organs during the somnambulistic state, more especially as to the sense of sight. Lélut, Guy, and others have believed that the somnambulist is able to see even with closed eyes. It is, however, by no *means* the case that the eyes are always closed, and

the dilated pupils would make it easy to see objects with very little light. It seems probable that usually objects are not seen, the sense of touch, which in these cases is often hyperæsthetic, to some extent taking its place. If a somnambulist writes, it frequently happens that no difference occurs in the writing, whether or not an object is interposed between him and the paper, and if the paper is moved he may be unable to cross a *t* or dot an *i* correctly. This was accurately observed even in one of the earliest reported cases, in Diderot's *Encyclopédie* (art. "Somnambulisme").

In respect to hearing subjects vary, but there is no doubt that in many cases they do hear, more especially when the remarks addressed to them are in relation to the dream that occupies them. Very often, if a somnambulist's name is called out, he turns and looks fixedly; he has heard, at all events, a sound, though he sees nothing.

In the same way the senses of smell and taste may be active, especially in relation to the subjects of the somnambulist's dream; one who asked for brandy pushed away a glass of water after having held it to his lips, and a somnambulist may eat a meal with apparent relish.

The sense of touch, as I have already remarked, is specially acute in somnambulism. All observers have noted this, and some have even declared that it replaces sight; this, however, can only be regarded as a metaphor. "Touches," as Bain remarks, "are associated with sight, connecting the tactile properties of things with their visible appearance, whereby the one can instantly suggest the other." Frank mentions a case in which a somnambulist

was able to recognise colours by the touch when her eyes were spasmodically closed. This, if correct, would be due to temperature differences. The ability sometimes shown, during this state, of drawing or doing very fine work is connected with this hyperæsthesia of touch. On the other hand, the pressure used in carrying the sleep-walker to bed may not be felt or be sufficient to produce awakening. Sometimes there is complete anæsthesia to pain, but this is, of course, consistent with delicacy of touch.

The motor system, under the guidance chiefly of the sense of touch, is in perfect condition, and, as is well known, may be capable of wonderful exploits. Speaking and singing are by no means uncommon, and the somnambulist may, moreover, be able to sing or play on an instrument better than in the normal condition. Mental processes can also be carried on well; although the remarkable statements concerning the achievements of sleep-walkers need careful sifting, there is no doubt that, for example, problems in Euclid can be worked out in this state, while school children who thus learn their lessons at night find in the morning to their surprise that they can repeat them correctly.[1]

In studying the medical literature of somnambulism it is seen that such cases are observed mostly in grow-

[1] D. Hack Tuke, art. "Sleep," *Dict. of Psych. Medicine;* Max Simon, *Le Monde des Rêves*, 1888, pp. 186 *et seq.* It is sometimes said that somnambulism is more common among girls than boys. This does not, however, seem to be the case. Anstie (*Lancet*, 1873) found that of 42 somnambulists 25 were male and 17 female. Somnambulism is chiefly prevalent in youth, and then boys are chiefly affected; after adult age is reached the conditions are reversed and women are much more frequently affected.

ing children, that is in subjects who are extremely in need of muscular exercise. At the same time there are cases on record in which the somnambulistic tendency was successfully treated by hard muscular work. In view of these facts it seems natural to ask if somnambulism is not an expression of motor dreams originating in muscles that are insufficiently exercised during the waking hours.

Hysterical Somnolence and Double Personality.—A morbid form of sleep closely related to those we have been considering, allied both to narcolepsy and to somnambulism, is that frequently called hysterical somnolence, and studied by Löwenfeld and others.[1] Such patients are suffering from cerebro-asthenia, or enfeeblement of consciousness, and remain for a long time in a drowsy or torpid condition, unable to make any sustained mental exertion, and falling into long and heavy sleeps, often without any attacks of real hysteria or somnambulism. If the tendency to somnolence is resisted there is a feeling of heaviness or constriction in the head, sometimes headache, and the eyelids feel weighed down. If the patient continues the struggle a state of excitement may result. Usually the somnolence gains the mastery, the will becomes paralysed, and the patient falls into the state of hysterical somnolence. Then there is a tendency for what has sometimes been called a second personality to emerge. Löwenfeld describes this second condition as the result of a subtraction from the first ego, rather than as an addition to it; it is not a second personality, but the first personality with some capacities enfeebled or in abeyance, especially the power of exerting the will, together with all

[1] *Centralblatt für Nervenheilkunde*, May 1895.

memory of the circumstances of ordinary life. It is not clear how this change takes place, beyond the fact that it follows on that process of brain exhaustion which is frequently met in hysteria. Löwenfeld thinks it may be a species of auto-intoxication. He has observed that in patients so affected the attacks of somnolence are preceded for several weeks by decreased appetite, diminished urine which (as its injection into guinea-pigs has shown) becomes unusually poisonous, increased constipation, and the loss of healthy sleep.

Sollier, who has also carefully investigated the matter, points out that this loss of healthy sleep is always a notable tendency in hysteria, and that it is associated with a remarkable tendency to temporary or periodic loss of memory, what might be called an anæsthesia of memory, during long periods of life. He finds in these two common tendencies of hysteria the germ which may easily develop into a second personality. "In many cases of ordinary hysteria," he remarks, "the patients are really plunged in a second state, or, more accurately, in a state of vigilambulism, and the absence of nocturnal sleep may then be due simply to the fact that they are in a pathological sleep." He mentions that hysterical subjects sometimes say, "I cannot sleep, because I am asleep all the time," or "I never know if I am awake or asleep."[1]

Medical literature relates many cases in which consciousness is divided into two or sometimes more parts, with a separate memory belonging to each part,

[1] P. Sollier, "Faits nouveaux relatifs à la nature de l'hystérie," *Atti dell' XI. Congresso Medico Internazionale*, 1894, vol. iv. (Psichiatria) p. 41.

and with similar divisions in the will and general character of the subject. Such a condition has been variously called double or duplex personality, *dipsychia* (Prichard), divided consciousness, etc. In such cases, after a sleep of varying depth and duration, the subjects on awakening can recall nothing. They may be obliged to learn over again all that they had learnt at school, reading, writing, arithmetic. They may not even remember the necessity for knowledge. This secondary state may last for a few days, a few weeks, even a few months; and then after a deep sleep or loss of consciousness, the subjects suddenly find themselves in their earlier state, with all their tastes and inclinations, their knowledge and character, and with no recollection of the secondary state. After a period of varying duration another sleep or attack of unconsciousness may again lead them into the secondary state with its acquisitions and its forgetfulness of the first state. This alternation of consciousness may last for years, the patients remaining unable to co-ordinate the two forms into a single picture, so that while they always recognise the persons they have known in one state whenever they are in that state, the same persons would be regarded as strangers if seen in the other state. The difference may even be deeper still, as in one case reported by Dufay de Blois, in which a girl of twenty-four, a somnambulist from childhood, who in one state was very short-sighted, was in the other state able to see excellently without her glasses.

To illustrate the varying nature of these alternations of consciousness I may briefly summarise two English cases which have recently been reported. The first is in a girl of twelve who was shown to the Clinical

Society of London by Dr. Albert Wilson in January 1896.[1] In this case there were no less than five different existences, including the normal, and the condition altogether is related to hysterical somnolence, or, more accurately, to hystero-epilepsy. In 1895 the child had had severe influenza, followed by great headache with intolerance of light and noise, probably meningitis, together with mania. After six weeks the headache disappeared and muscular symptoms of twitchings and opisthotonos developed, with lividity and coma. She had many fits a day. In June the old symptoms disappeared and a fresh train of phenomena appeared. When in an apparently normal state she would shake, turn a somersault, and enter a new and different mental state. Her memory for all events during health was quite gone; but she would remember in one such fit what had happened in a previous one. Thus was established a complete dual existence. By education she learned the names of most things, but always employed baby pronunciation. She would write backwards and that quickly. When these attacks developed she lost all power of walking or standing till about August 1895. In the early stage she had fits of catalepsy, chiefly rigidity of the flexors. At times she had five or six fits a day, lasting a few minutes, and at her worst periods they lasted for days. She recovered from them quite suddenly, was never surprised at her surroundings, but very composed, and said she remembered nothing during the attack. The most striking feature was once when she had severe toothache during an attack. Wilson gave chloroform and removed two teeth. On regaining consciousness she recognised that the teeth

[1] *Brit. Med. Journal*, 1st February 1896.

and pain were gone. Her father hypnotised her and brought her to the normal state when she made the discovery of the blood and the loss of the teeth, but she never remembered the previous pain or taking chloroform. There had been many variations, and she had four different existences besides the normal: (1) "Nib" for "Old Nick" when she had violent passions, and would bite or slide down the banisters; (2) "dreadful wicked thing," when everything was reversed, black being white, asleep being awake, the head being the foot, and so on; (3) "Allie" when she was amiable and good; (4) her ordinary fits, as already described. Other phenomena occasionally occurred. Thus, she was at times completely deaf and dumb, or there might be loss of memory, so that she did not know those whom she ordinarily knew during the fits. Her general health and nutrition were good. She had not yet menstruated. Treatment had been rest and quiet and fresh air. Two years later, however, her condition remained the same, except that the abnormal periods were more prolonged, and during them she was almost blind, although there were no changes in the eye. She was slightly imbecile in manner, but could draw and even paint in the blind state.

In another case, reported by Dr. Lewis C. Bruce, the dual brain action was very pronounced, though here the duality was complicated by insanity.[1] The patient varied considerably in his mental condition during the two states, the most obvious phenomena observed being that in one condition he spoke the English language, and in the other the Welsh language. When in the former state he was the

[1] *Brain*, part lxix., 1895.

subject of chronic mania. He was right-handed, and exhibited a fair amount of intelligence. He remembered clearly things he had noticed in previous English periods, but his memory was a blank to any that occurred during the Welsh stages. He wrote by preference with his right hand, his letters were fairly legible, and he wrote from left to right. When in the Welsh stage, however, he was left-handed and the subject of dementia. If asked to do so, he would write with the left hand, but then produced mirror-writing, traversing the paper from right to left. His speech was almost unintelligible, but what could be understood was in the Welsh language. In this stage he had no knowledge of English. In passing from one stage to the other he was often ambidextrous and spoke both languages. His pulse was also different, being full with high tension in the English stage, weak with low tension in the Welsh stage.

Both the foregoing cases are clearly associated with disease. In typical cases there is often no obvious sign of disease, even of hysteria. This was so in a case I may quote, which is of interest both as being typical and as being probably the earliest case recorded. It was observed in England in 1816, and described by Combe and by Macnish. In this case a young lady of naturally very good constitution reached adult age without any mental or physical disease. She possessed excellent capacity and good memory, and was highly educated according to the standard of the day. Unexpectedly she fell into a deep sleep, which lasted several hours beyond the ordinary term. On awaking, it was found that she *had lost* every trace of acquired knowledge. Her

memory was a *tabula rara;* she had to re-learn everything, to become acquainted with the persons and objects around her and their names, and to re-acquire the arts of reading, writing, and arithmetic. She made considerable progress, however, in learning, and some months later she fell into another fit of somnolency. When she awoke she was restored to the same condition in which she was before the first sleep, and moreover she was wholly ignorant of everything that had occurred during the intervening months. She was as unconscious of her double character as two distinct persons. These periodical transitions continued for over four years, the alternations being always preceded by a long and deep sleep. At the time this case seems to have stood alone. From that date until 1858, when Azam of Bordeaux aroused interest in the subject by his careful study of Félida, a similar subject, this condition seems to have passed unnoticed, or else such cases were dismissed as merely insane or hysterical and not worth further investigation.

In some cases, which are, however, rare, the duplex personality appears as a sudden explosion in an apparently normal individual, leading him to abandon family and home in a state of complete unconsciousness for weeks, months, or even years. I will present as an example a case which Dr. A. E. Osborne observed a few years ago in Pennsylvania.[1] The subject was a man of muscular, somewhat angular outline, past middle-age, in admirable health, and so far as is known free from any personal or inherited neuropathic taint. For many years he had resided in a thriving town near Philadelphia, and, by strict

[1] Osborne, *Medico-legal Journal*, June 1894.

application to his trade as a tinsmith and plumber, had accumulated considerable means. With these resources he at last opened up an establishment of his own, and, being singularly industrious and straightforward, he prospered steadily in his business. As his sons grew up they shared in the business, and at the time of his disappearance had materially assisted him in the execution of some large contracts, from which he realised handsome profits. For years he had enjoyed ordinarily good health, and was not known to possess any eccentricities or morbid tendencies. His domestic relations were harmonious, his social position better than ever before, and he was not known to have any secret, immoral, or illicit indulgences of any kind whatever. The Sunday of his disappearance he had remained in the house all day, as it was a dull, gloomy November day, engaged mainly in reading and in play with his younger children, to whom he was greatly attached. About four o'clock in the afternoon he got up from the lounge on which he had been reclining, reading, changed his house-jacket for an ordinary business-day coat, slipped on an easy pair of shoes, and, to his wife's questions, stated he was going out for a short walk in the street "for a little fresh air." Noting the time, she cautioned him not to go far, as they would soon have dinner. He promised not to keep them waiting, declared he would be back in a few moments, and that he was only going for a little turn in the main street, on which his house faced. He quietly and leisurely stepped outside the door, and although a conspicuous figure in the town and perfectly well known to nine-tenths of the people of the vicinity, he disappeared as *mysteriously* as though he had, as they say, "vanished

into thin air." None of the townspeople saw him, although the streets were alive with the usual Sunday afternoon strollers. He left no trace. Rewards and detectives proved unavailing. When it was necessary to wind up the affairs of the establishment, it was found that he had taken no money, but that his wife and family were handsomely provided for. In due course of time the business was finally disposed of, the property sold, and the wife and family removed to Chicago. The family gave up all hope of ever finding even a clue to the long-lost husband and father. Two years had almost passed when in a tin-shop in a town in one of the far Southern States, where a number of men were engaged at their trade, suddenly one of them dropped his work and cried, as he pressed his hand to his head in a dazed, bewildered way, "My God! where am I? how did I come here? This isn't my shop. Where am I? what does it mean?" At first the men were disposed to laugh at the reserved man, who had worked for several months so quietly by their side, and of whose history they had not been able to learn a word, but when they saw his changed expression, the perspiration standing on his brow, his nervous twitchings, and noted his piteous appeals, they realised that it was all something far from jest, and, as he was known as a sober, most exemplarily behaved man, they could not charge him with inebriety. They called him by a name that was now strange to him, and they insisted he had told them such was his name. At last, trembling with suppressed emotion, he made his way to the proprietor, who was quite as much startled by the man's talk and manner as had been the men below. After

months of wandering and of work combined, during which period he had aged considerably, he was now awakening from—shall we say his somnambulistic sleep? It was with some difficulty that he made the proprietor understand his true condition or believe his story of a Northern home, a family, and a prosperous business. The proprietor only knew him as a wandering tinner who had drifted into the town, sought work at his trade, was employed, proved to be a reliable, skilled, and attentive workman, and regarding whose antecedents the proprietor had not inquired and the workman had not volunteered any statements. Under the fictitious name he had given he had been known and paid, but he had no knowledge of the past. He remembered nothing. At last a dim recollection came over him of that fateful Sunday, his rising to go out, the request to come back for dinner, his promise to do so in a few moments, and then all was a blank. He had no money, although he had worked steadily for some months in this shop, and had been paid good wages. What he did with the money, it seems, has never been discovered. After ascertaining the whereabouts of his family, he made straight for Chicago, where, by the last accounts, he was living his usual normal life. Somewhat mystified over his realisation of the strange freak in which he figured, although feeling well and apparently in normal mental balance, he yet realises that he has been the central figure in some over-strange mental phenomena, quite mysterious enough to make him, at times, doubt his sanity. There are no facts explanatory of the prime cause of his disappearance, to account for the failure of his neighbours to detect his flight, to explain his wanderings,

or to solve the conditions of his return to his normal self.

Dr. Osborne reports another case in which a young Irish coachman, on being thrown from his vehicle and considerably injured, wandered away in a state of second consciousness. Dr. Drewry has also reported a case in which a merchant, apparently in excellent health, suddenly changed consciousness while on a steamer, only returning to normal consciousness after six months; in this case the bursting of an abscess in the auditory canal coincided with recovery, a very significant fact.[1] Tissié of Bordeaux has narrated at length (and summarised in his book, *Les Rêves*) the history of a man whom he knew for many years, and whose whole life has been a series of romantic adventures due to perpetually recurring phases of second personality. His attacks start in a dream that he is to go to a certain place; usually some one in the dream offers to give him work, which it is his constant desire to find; for he is a hard-working man and anxious to better his position and that of his wife, whom his escapades have reduced to misery. Then he awakes, or seems to awake—for the dream is really continuing—and sets off. In this state he can walk as much as seventy kilometres or more a day, and weeks or months elapse before he returns to normal consciousness. He knows all the prisons of Europe, being frequently arrested as a vagabond,

[1] W. F. Drewry, "Duplex Personality," *Medico-legal Journal*, June 1896. In the *Medico-legal Journal* for Dec. 1893, Dr. H. Hulst ("Artificial Multiple Personality") narrates in careful detail the interesting case of Miss Sadie V., who had three states of consciousness. Dr. Hulst finds a reflection of the facts of multiple personality in mythology and folk-lore, in the stories of swan-maidens, of Melusina, etc.

and many of its hospitals. He has visited the whole of France, besides Algiers, Germany, Holland, Belgium, Turkey, Hungary, Switzerland, and Russia—where he was nearly hanged as a nihilist—almost always on foot and in a state of dream or secondary consciousness. He is the modern wandering Jew.[1]

It is still impossible to explain such division of consciousness, but the facts instinctively recall the old theory of Wigan,[2] according to which we all really possess two brains, each cerebral hemisphere representing a complete brain, with this difference, that in right-handed persons it is the left hemisphere which attains most complete development, and in left-handed persons the right hemisphere. This theory has been to some extent revived since Wigan's day by Sir Samuel Wilks,[3] and also by Brown-Séquard.[4] Lately, Dr. L. C. Bruce, founding his arguments on cases of his own of unilateral right-sided epilepsy, has attempted to give further precision to the conception of dual brain action, by reference to the phenomena of epilepsy. He argues that the unilateral epileptic storm disorganises the one hemisphere, leaving the other hemisphere to carry on consciousness. The conclusions drawn from these observations were that in the normal state of these patients the left cerebral hemispheres controlled the functions of the right, the mental development of which must have been low either from atavism or from congenital deficiency not

[1] The problems of double personality, which do not concern us here, except in so far as this state is a further development of the somnambulistic state, may be studied in Binet's *Alterations of Personality* (English edition, edited by Professor Baldwin, 1896).

[2] A. L. Wigan, *The Duality of the Mind*, 1844.

[3] *Guy's Hospital Reports*, 1872, pp. 161 *et seq.*

[4] *Lancet*, 1876, vol. ii. p. 75.

having the capability to develop. He points out the relation between the state of epileptic automatism following attacks of *petit mal* and the states of consciousness previously described, and also the loss of inhibitory power, and tendency to irritability common to all patients subject to epilepsy. In the brains of those who through heredity were predisposed to epilepsy and the allied neuroses, there was possibly a considerable difference in the mental development and education of the two hemispheres. Such a condition would render a man more liable to brain fatigue. The whole character of the incipient epileptic was that of a man with a brain easily exhausted. Given a heredity to the neuroses, there is no great step to that sudden discharge of energy which we name epilepsy. Dr. Bruce therefore suggests that in some cases of epilepsy the disease is due to a want of equal education or development in the two cerebral hemispheres, thus rendering the patient liable to unusual brain exhaustion.[1]

However this may be, pathological and anatomical observations have well established the fact that the organs of speech, and consequently the chief organs of thought, are in right-handed people localised in the left cerebral hemisphere and in left-handed persons in the right hemisphere. This difference in the localisation of the speech centres, according to the predominance of the right hand or the left, is connected with the decussation of the nerves, those from the left hemisphere going to the right side of the body, and from the right hemisphere to the left

[1] "On Dual Brain Action, and its Relation to certain Epileptic States." Paper read to Edinburgh Medico-chirurgical Society, Feb. 3rd, 1897.

side. Observations which I have carried out on persons suffering from left-sided migraine have shown that during this hemicranial pain the left hand temporarily acquired the ability to write better than usual, a fact which I explain by supposing that during left hemicrania the right cerebral hemisphere becomes unusually active. On the other hand, I have also found by direct observation that if during the early hours of deep sleep we tickle the sleeper's face on the right side of the median line, the same result always follows: the sleeper acts as though he were driving away a troublesome fly, and always with the left hand, even although he may be lying on his left side and the action of the left hand is thus impeded; the right hand remains motionless, though it may be lying freely by the body. I have repeated this experiment on fifty-two persons of varying age and both sexes, from children of three to men and women of over sixty. In every case the result was the same: during the first two or three hours of sleep (when it is deepest, according to Kohlschütter) it was always the left hand which made the movements required to brush away this unpleasant tickling. It thus became a matter of interest to ascertain whether left-handed people resemble the right-handed in this respect, and, thanks to the complaisance of some of my friends, I was able to observe eight individuals who were almost completely left-handed—that is to say, who wrote, ate, sewed with the left hand, though at the same time executing various movements with the right hand, such as making the sign of the cross or combing the hair; among them was a man who had served in the army and who was right-handed *with his rifle*. All those persons, when tickled with

a feather during deep sleep, made a movement as though to brush away a fly, *and always with the right hand*, even although they were lying on the right side with the right arm beneath them, and the left lying free. They used the right hand in the same way as right-handed people use the left hand; in other words, the hand most active during waking life remained motionless during sleep, its functions being undertaken by the other hand.[1]

These facts may be explained on the hypothesis that the most active cerebral hemisphere is resting during the hours of deep sleep, since there can be no doubt that, as Broca used to say, the right-handed are left-brained, and the left-handed right-brained.

There are other observations which support this view of the supplementary functions of the cerebral hemispheres. During my investigations into the effects of complete insomnia on puppies I constantly observed that the reflexes disappeared and reappeared periodically, first in the limbs of one side, and then in those of the other, the animals, enfeebled by sleep, becoming insensible to the different irritations of the skin. It appeared that the animal's insensibility was not stationary, but in a migratory condition; after continuing from ten to twenty minutes on the right side of the body it was transferred to the left side, irritation of the left side not again producing reflex movements until there was a fresh transference of insensibility. Puppies deprived of sleep produced on me, and those who were associated with me in the experiment, the same impression as if they slept

[1] For these and similar experiments see Marie de Manacéïne, "Suppléance d'un hémisphère cérébral par l'autre," *Arch. ital. de Biologie*, 1894.

sometimes on one side of the body, sometimes on the other. In other words, the cerebral hemispheres seemed to supplement each other periodically, one acting while the other was inactive.

From another side, Wigan's theory has received support from the experiments of Professor Goltz, who, on removing the left hemisphere of a dog's brain, observed that the animal presented very few changes when compared to normal dogs. The dog with one hemisphere presented some enfeeblement of intelligence, the muscles were not so strong, and sensibility was less perfect on the right side than on the left; but to a superficial observer he seemed completely normal. In presence of this fact Goltz concluded that cerebral tumours and similar affections may safely be treated by surgical methods, provided the disease is limited to one hemisphere.

If we could admit with Wigan that each cerebral hemisphere represents a complete brain, we could explain double consciousness by supposing that in this case the hemispheres predominate in turn, the general consciousness binding together the two being absent; each hemisphere acts by its own consciousness, the anatomical basis which unites the elements of consciousness being in a state of inactivity.

All these hypotheses seem, however, to be insufficient in face of the cases to which I have already referred, in which there are more than two states of consciousness. In a case studied and described by Bourru and Burot there were not less than six successive states of consciousness, each with its own tastes, inclinations, knowledge, memory, character, and even physical symptoms, in the *paralyses* and anæsthesias affecting the patient. Such

a case resists explanation, unless we assume that the brain as a whole becomes segregated into various districts which work successively.[1] Or we might be content to adopt the easy explanation that such cases are simply examples of the perverse simulation often found in hysterical subjects. But then we should still have to ask what simulation is. Moreover, we have to admit that there is a gradual progression from the simplest cases of sleep-walking to the most extraordinary phenomena of divided consciousness.

We have thus still kept strictly within the region of pathological sleep. The most elaborate and developed states of multiple personality are, as Azam has shown, simply states of total somnambulism, and such persons are nothing else than somnambulists all whose senses and faculties are active.[2] We may accept this conclusion while admitting that we are incapable of explaining the pathological symptoms either of sleep or of consciousness. We may, however, console ourselves with the thought that this impotence cannot last, and that the time will come when the progress of investigation will enable us to reach and to explain even this obscure region of our life.

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[1] See W. W. Ireland, art. "Double Brain," *Dict. of Psych. Med.*

[2] E. Azam, art. "Double Consciousness," *Dict. of Psych. Med.*

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CHAPTER III.

THE HYGIENE OF SLEEP.

How much Sleep is necessary?—Lowering of the Body Temperature under the Influence of Swinging—Conditions determining an increase of Sleep in Old Age—The Effect of Habit on Sleep—The injurious Effects of Excessive Sleep—Temporary Albuminuria caused by Prolonged Sleep—Nocturnal Paralysis—The Conditions favourable to the Development of Anæmia—Infants at the breast should not Sleep too long—Methods of combating the excessive Tendency to Sleep—Methods of combating the Tendency to Insomnia—Hot Baths—The Application of Cold Water to the Head—Supper—Injurious Effects of burdening Digestion—The Influence of Light—The Effects of Darkness—Why Darkness is feared—The Temperature of the Bedroom—The Effects of Impure Air—The Position of the Body during Sleep—The Hour for Rising—Ventilation and Sunlight—The Habit of Breathing through the Mouth—Sudden starts in Sleep—Dreams of falling or flying—Sleep during Illness—The Sleep of Consumptives—Sleep in Cardiac Affections—The Influence of Tobacco—The Hypnagogic State.

SINCE we devote so much of our life to sleep, it is natural to ask how, and how long, we ought to sleep.

Amount of Time to be devoted to Sleep.—Usually the amount of sleep is in an inverse ratio to the strength and development of consciousness; thus children need more sleep than adults, since the development of consciousness is moving more or less parallel with increase of age. In infants at the breast consciousness is so feebly developed that a very brief period of waking

life suffices to produce exhaustion. Owing to the demands of rapid growth the phenomena of metabolism and nutrition predominate over those of active circulation. The labours of Soltmann, Tarchanoff, and others have shown that the anatomical mechanism of the higher intellectual processes remains in a rudimentary state for some time after birth. During the first day or two, as Preyer has shown, the infant even shows no signs of sensibility when pricked with a pin, and the ability to speak only begins to appear very slowly and gradually, after many months. At this period the sleeping must necessarily predominate over the waking state, the unconscious reflex life over the conscious intellectual life.

Moreover, nurses, servants, and sometimes even mothers, like young children to sleep as long as possible, for the selfish reason that the longer the child sleeps the more free time they have. In presence of this fact it is necessary to remember that prolonged sleep may be harmful, since consciousness requires exercise for its development, and thus the new-born infant must not be allowed to pass all its hours in sleep. For the same reason all the methods of putting children to sleep artificially by means of monotonous sensations ought to be proscribed, including monotonous and unmusical lullabies and the rocking of babies in cradles or simply in the arms. I have found by direct experiment that swinging, even for only a quarter of an hour, produces in healthy adults a lowering of temperature of 0.5° C., and more or less pronounced phenomena of brain anæmia and pain at the heart. The decrease of temperature may be as much as 1.5° C., and Alexandre in the beginning of the century even proposed to swing

patients in fever to reduce the temperature. Rocking a child in the arms or the cradle produces sleep artificially, partly because consciousness is fatigued by a series of monotonous sensations, and partly because at the same time artificial anæmia of the brain is provoked. Those authors who assert that the cradle is a fruitful source of human stupidity, and even of idiocy, have not therefore been altogether wrong, though they supported their assertions by no experimental facts. In Germany it is proverbial to say, "He has been rocked into stupidity;" which seems to indicate that the injurious effect of the cradle on infants has been popularly recognised.

It is, therefore, undesirable either to interrupt or to artificially produce or prolong the sleep of infants and young children. During the first four or six weeks of life there ought to be two waking hours during the day, and as the baby grows the duration of this period should gradually increase. Between the ages of one and two years, children need 18 to 16 hours of sleep out of the 24; between two and three years of age, 17 to 15 hours; between three and four years, 16 to 14 hours; between four and six years, 15 to 13 hours; between six and nine years, 12 to 10 hours; between nine and thirteen years, from 10 to 8 hours. At the critical age of puberty, during the transition from childhood to adolescence, the duration of sleep should be somewhat augmented. At the end of this period it may be reduced to from seven to nine hours; and only after the completion of growth, at the age of nineteen or twenty, can it be safely brought as low as 6 to 8 hours a day. Those who have reached middle age, the age at which consciousness and the other psychic faculties have

attained the zenith of their development, may content themselves with even less, but only so long as they are in perfect health. On the whole it may be said that eight hours is, on the average, the amount which adults may most wisely devote to sleep.[1]

As regards the aged, the amount of sleep must vary with the state of consciousness and the degree of its enfeeblement. If as old age approaches consciousness grows weaker, together with the intellectual sphere generally, the need for sleep is the same as with young children; I have already mentioned the case of the distinguished French mathematician, Moivre, who slept twenty hours a day during the last years of his life. In such cases there is a marked enfeeblement of memory also, as was the case with Linnæus, who in old age, having taken down one of his own books, immediately forgot that it was his and exclaimed with delight as he read it, "How fine this is! What would I not give to have written that!"

If, however, the intellectual powers are well preserved in old age, the need for sleep is much less, and we may even find a tendency to insomnia. This is easily explained, since the conditions of life in old

[1] This was the conclusion reached by Dr. Binns in his interesting old work on *The Anatomy of Sleep*, p. 36: "Alfred," he remarks, "divided the twenty-four hours in the following manner: eight hours for rest, eight hours for labour, and eight hours for amusement. Jeremy Taylor allowed but three hours of the twenty-four for sleep; Baxter, four; Wesley, six; Lord Coke and Sir William Jones, seven; Sir John Sinclair and Dr. Elliotson eight hours of the twenty-four. Nine, however, will frequently be found not too much for literary men." It is said that Bismarck and Gladstone in old age both sleep eight hours; Zola only sleeps seven hours. Many other great men—such as Goethe, Napoleon, Humboldt, Mirabeau, etc.—have devoted even less time to sleep. Kant, who only slept for seven hours, though in old age he was obliged to increase this amount, regarded the bed as the nest of diseases.

age more or less remove the causes of the exhaustion of consciousness. We may recall that in persons of advanced years the passions retire into the background, while the tastes, convictions, and character become more fixed. Consequently we rarely find that internal contest of the man with himself, that struggle of noble ideals with selfish tendencies which consumes so much of the strength and health of youth. It is clear that in the absence of this internal struggle, old men who have preserved their vigour must become much less fatigued than adults; hence they are liable to insomnia.

Bearing in mind that an excess of sleep leads to a still further enfeeblement of consciousness, in old age as in infancy, and thus is harmful, old men, and all those who have an undue tendency to sleep, should be counselled to abstain from suppers, for Durham's observations have shown that the introduction of food before sleep considerably increases the brain anæmia which accompanies sleep. Massage of the body and cold baths may also be recommended, and friction with a sponge and cold water.

However great the tendency to sleep, the aged should not sleep for more than ten hours, only in cases of marked feebleness for twelve hours, and then there should be two periods of sleep. It must be remembered that the organism grows accustomed to everything, even to what is injurious. Thus by habit it is easy to sleep at any hour of the day, in a particular position, or under the influence of a particular sensation. People sometimes fall asleep by putting the hands into a certain position, or by looking at a bright object (Hammond, Ball). Those persons who have an exaggerated tendency to sleep should therefore

combat it as far as possible, or it may increase by mere habit. It is clear that the phenomena of nutrition and the renewal of the tissues cannot be prolonged indefinitely; they are limited by the demands of the preceding expenditure. If, therefore, a man sleeps longer than the repose of consciousness and the repair of the tissues require, there will, in the first place, be an enfeeblement of consciousness from lack of exercise, and, in the second place, an adaptation of the vessels to an abnormal state of the nutritive circulation, to the detriment of the functional circulation; consequently we may have ground to apprehend trouble in the respiratory exchange and an over-production of carbonic acid—not a matter of indifference to the organism, which may sooner or later be injured thereby.

The nutrition of the brain may deviate from the normal standard, not only quantitatively but also qualitatively, and thus, for example, receive too large an amount of lecithin and albuminoid substances (Hughlings Jackson, Thudichum); some authors attribute epilepsy, a disease involving the interruption of consciousness and tending to produce stupidity and even idiocy, precisely to this excess of albuminoid alimentation. I have already mentioned that epileptic fits frequently appear during nocturnal sleep. Attempts have been made to treat epilepsy on the one hand by a diminution of albuminoids in the diet, and on the other by the ligature of the vertebral arteries in the neck (Alexander, Reyer), both with a certain success. Food may thus be injurious either quantitatively or qualitatively, and by excessive albuminoid nutrition. From my own personal observations I have gained the conviction that too much sleep is equally

harmful at all ages of life. In childhood, especially, it over-develops the vegetative life of the organism, simultaneously enfeebling the cerebral nervous system. If we compare the children who sleep much with those who sleep little it is easy to see that the first are better nourished and fatter, but the muscular system is often much weaker than in the normal condition. At the same time they exhibit the phlegmatic temperament and a delay in intellectual development. On the other hand, children who sleep little are for the most part nervous and precocious. The normal development of the intellectual powers—neither too slow nor too hasty — demands that there should neither be excess nor deficiency of sleep, but correspondence to the real needs of the organism.

The Effects of Excessive Sleep.—Since sleep is accompanied by more or less inactivity of the chief organs and tissues of the body, and all prolonged inactivity leads to enfeeblement, excessive sleep must necessarily weaken the vessel walls, which may lead further to serious consequences. I may mention as an example that by repeated observations I have found that a prolonged sleep of ten or twelve hours in childhood, and more especially during adolescence, may lead to temporary albuminuria. And it is well known that the presence of albumen in the urine, even if the kidneys are quite healthy, is always a disturbing symptom, for it indicates that the renal tissue is becoming habituated to allow the albumen to filter through, and so in the long run to interfere with the normal functions of organs of the first importance for life. Such albuminuria is always observed in those boys or girls who, once in bed, sleep continuously till morning, not waking even

to empty the bladder. On awakening they discharge an abundant amount of healthy urine; a few hours later, however, after walking, playing, etc., it is much less in amount, but is found to be albuminous. Towards evening it again becomes normal, notwithstanding the fatigue of the organism. The origin of this kind of albuminuria may be easily explained; during the ten or twelve hours of sleep so large an amount of urine has accumulated in the kidneys, ureters, and bladder, that all these organs are distended and their tone enfeebled. When the child awakes, the discharge of the accumulated urine is not sufficient to restore the normal tonicity of the tissues; the blood pressure in the kidneys is increased in the standing or sitting posture, and under these influences the renal tissue allows more or less albumen to pass out of the blood. The correctness of this explanation is shown by the fact that if we awake children after four or five hours' sleep and make them empty the bladder, albumen disappears completely from the urine of the day. The mechanism by which albuminuria develops in such cases thus recalls that observed during compression of the ureter. No attention is at present paid to this source of albuminuria, because it is unfortunately not considered necessary to examine the urine of apparently healthy persons. My own observations have convinced me that albuminuria due to such retention of urine as I have described, continuing for a year or two, may gradually increase so that the amount of urine during the day may be 2 per 1000. Evidently the renal tissue becomes habituated to this passage of albumen. It is obvious that these losses of albumen must *weaken* the nutrition and energy of the organism,

and at the same time prove a possible source of serious disease of the kidneys, as Noorden has shown in treating the question of physiological albuminuria.

This example will, I think, suffice to show that prolonged sleep may not only be injurious to psychic health, but also to physical health, even in youth.

In old age the tonicity of the tissues is already more or less enfeebled, and excessive sleep must act upon them still more perniciously, contributing to produce various forms of blood stasis, and reacting on the general nutritive phenomena of the organism; in some cases such stasis, combined with enfeebled tonicity of the vessels, may lead to the forms of apoplexy due to hæmorrhage. Excessive sleep may also prove injurious from the absence of habitual stimulation, and from uniformity of position. We all know the unpleasant results of numbness of the extremities; but sometimes uniformity of position during sleep provokes not only numbness and insensibility of the limbs, but also complete paralysis, as direct observation has shown. In medical literature we may find a series of cases of nocturnal paralysis, as described by Weir Mitchell, Ormerod, Sinclair, Saundby, Féré, Schreiber, and others.

Excessive rest in bed may also lead in adults and the aged to the development of biliary calculi, since during peaceful and prolonged sleep there is a stasis of bile in the gall bladder, still further favoured by the slackening or arrest of the peristaltic movements of the intestines and by the position adopted in sleep, which may prevent the flow of bile into the duodenum from many physical reasons, such as the

compression of the gall duct. During stagnation of bile its liquid portions are absorbed, and it thus becomes thicker and more easily tends to form biliary calculi and gravel. A similar condition in the urinary passages may form the starting-point of stone in the kidney or the bladder, and for this reason also it is desirable to avoid a prolonged stasis of the renal secretion in the urinary passages.

I may remark also, in passing, that prolonged sleep, by enfeebling the tone of the digestive canal, contributes to develop habitual constipation with all its unpleasant results. In early childhood as well as in youth there is often much suffering due to obstinate constipation, and by attentively investigating such cases we may discover that these subjects sleep too much; it is sometimes sufficient to make them get up earlier, to cure obstinate constipation and improve the general nutrition of the organism.

An eminent English physician, Sir Andrew Clark, attempted to explain the development of anæmia in young girls by the influence of the obstinate constipation with which it is usually associated, and he even proposed to call anæmia or chlorosis simply fæcal anæmia. He was only mistaken on one point: obstinate constipation is not so much the essential cause of the disorder as one of its manifestations. In my opinion the cause should rather be found in albuminuria, which has developed from not being recognised in time. In support of this opinion I may refer to the fact, pointed out by many authorities, that albuminuria is frequently found in young girls and young people generally at the period of puberty, although there is every reason to con-

sider the kidneys healthy. In these cases the albumen is constantly observed in the urine discharged during the day.[1]

It must not be forgotten, also, that anæmic young women are always remarkable for their sleepiness; they adore sleep, they cannot bear their sleep to be interrupted. For this reason we may very often find that they allow an excessive amount of urine to accumulate during the night, thus dilating the urinary passages, and, as I have already pointed out, this may lead to the development of habitual physiological albuminuria, which, gradually increasing, may finally produce all the results of severe anæmia and pathological albuminuria. In treating chlorosis it is thus desirable to diminish the time devoted to sleep, and also to avoid too prolonged a retention of the urine during the night. We must also bear in mind that in adolescence, the period of sexual development, the blood is specially drawn to the organs of the pelvis and the abdominal cavity, and consequently that any derangement in the normal course of the renal functions may easily have injurious effects. Under the influence of general disturbances of nutrition and excessive sleep the muscular tone of the digestive passages becomes weak; obstinate constipation appears; and these conditions, again, react harmfully on the state of the kidneys and the general nutrition of the organism.

After all that has gone before, it will easily be understood that even infants at the breast need not

[1] Among the authors who have dealt with the question are Vogel, Gull, Morley Rooke, Clement Dukes, Moxon, Randall, Capitan, Fürbringer, etc. For references see the bibliography at the end of this chapter.

only time to sleep but also time to wake. Continuous cerebral anæmia must necessarily enfeeble the brain. Its conscious activity is always accompanied by a marked afflux of blood to the organ, and very active cerebral circulation; consciousness is thus developed gradually and increased by continuous exercise and persevering work. The law which regulates development and growth is the same for all the tissues and all the aptitudes of the organism; and just as a muscle which is always at rest atrophies, grows weak and disappears, so it is also with an inactive nerve, the sense organs, the anatomical mechanism of the different psychic functions when unused.

For those persons who show an excessive tendency to sleep, all those means are useful which produce a notable afflux of blood towards the brain: stimulating drinks like tea and coffee, pleasant society, amusements, etc. In this connection it is interesting to note the case communicated by Erasmus Darwin. A friend of his was obliged to ride much and consequently often became very fatigued; sometimes he was so tired and sleepy that he could scarcely keep on his saddle; but he found that to remove the painful feeling of fatigue it sufficed to think of something that irritated him; his anger accelerated the circulation and acted as a stimulant. Some physicians even regard favourably the exaggerated irritability of exhausted and anæmic persons, since by becoming perpetually angry over insignificant trifles these persons improve their cerebral circulation and consequently their general health. For these reasons it may be advantageous for somnolent persons to engage in warm discussion, to play at

cards, even to give way to anger, for in so doing they provoke an afflux of blood to the brain.

Joy also causes the blood to flow to the brain and so directly stimulates the functions of the central nervous system, and indirectly the whole organism. Ambroise Paré was thus to some extent right when he said that in disease the cheerful recover more easily than the sad. It must be remembered that the tendency to somnolence may be observed not only in children and the aged, but also in adult age and even in young people, when it may be caused by idleness and inactivity, the absence of all absorbing interests and occupations. On this ground we can well understand the tendency to sleep shown by children, savages, and the uneducated, when not occupied, for their psychic world is so poor that it is almost impossible for them to find any interest in their own thoughts and ideas. They always need stimulation, impressions from the external world, or they fall asleep under the influence of the monotony of their own internal world. We must therefore procure them occupations, in no serious sense of the world, but such as correspond to the general level of their psychic development. There are persons who find a serious and interesting occupation in observing whether all their clocks strike simultaneously or in a certain order; others devote the time left over from sleep and meals to the care and feeding of birds, etc.; others again occupy themselves with table-turning, playing at patience, and so on. Such occupations, proportioned to the intelligence of each, are necessary to overcome the exaggerated and harmful tendency to sleep.

The Hygiene of Insomnia.—Leaving the subject of

excessive and superfluous sleep, we must now turn to that of insufficient sleep, with the causes of which we were concerned in the last chapter. I have already pointed out that it is not rare among the aged who have preserved their intellectual energy, and who, in consequence of the natural conditions of their age, have no sufficient reason to fatigue consciousness. Insomnia is observed at other ages of life, but is rare in children, in whom it indicates great excitement of the central nervous system; such children should be carefully examined. There is often obstinate insomnia which consists not of a complete absence of sleep, but of light, brief, and interrupted periods of sleep disappearing under the influence of the slightest noise or any external stimulus. Such light and broken sleep is harmful, because it gives the tissues no time for repair, and after such a night, passed in alternately drowsy and waking states, there is no refreshment, but on the contrary a feeling of greater fatigue, with exaggerated excitability and inability to accomplish serious intellectual work.

Since normal sleep demands the fatigue of consciousness and the production of cerebral anæmia, it is evident that whatever will induce these conditions serves to combat insomnia. The subjects of insomnia should, therefore, devote their evenings to uniform occupations in a uniform environment, avoiding visits or any source of excitement. As a sedentary life develops irregularities of the circulation, they should also be careful to take sufficient physical exercise. Under the influence of civilisation many classes of society suffer from lack of sufficient muscular exercise. To realise the extent to which civilisation has eliminated muscular labour from daily life, it is sufficient to

recall that in order to supply the amount of flour necessary to feed the household of Penelope twelve women had to grind at the mill day and night; while to-day, by means of mills worked by machinery, it is easy to prepare in the same time sufficient flour to feed five thousand men. In other words, the amount of manual labour which to-day suffices to feed five thousand men would then only suffice to feed ten or at most twenty. In the same way mechanical methods of locomotion have largely rendered unnecessary both walking and riding. The dreams of Aristotle concerning self-acting mills and weaving shuttles are completely realised, not, however, without unfortunate consequences on the one hand in the growth of a proletariat, and on the other in lack of useful muscular labour.

Warm baths in the evening greatly contribute to prevent insomnia, if properly carried out. As recommended by Eccles and others, the bath should be taken in a room with a temperature of 65° to 70° Fahr. The patient should stand with his head over the edge of the tub, douching head and face with water at 100° The cooling of the body by the air and the hot sponging of the head first send blood to the brain, dilating its vessels. Then the entire body, except the head, is immersed in a bath at 98°, rapidly raised to 105° or 110°; in a few minutes the bath is left, and the body wrapped in blankets which absorb the moisture, and with the least possible exertion the patient gets into his night clothes, and to bed, with a warm bottle to his feet, and perhaps a little warm liquid food. The sedative and refreshing results of this process are often very marked.

When for any reason it is undesirable to use hot

baths, the application of cold water in india-rubber bags is often useful. In the same way, standing in cold water and then rubbing the feet with a rough towel may be recommended. To lie with the back of the neck on a hot-water bottle, as Broadbent has pointed out, is another method of setting up local hyperæmia, and thus reducing cerebral arterial tension and promoting sleep.[1] In this connection it is interesting to note that, as Binns pointed out, Spanish women are accustomed to get their children to sleep by rubbing the spine between the cervical and the lumbar vertebræ with the hands.[2]

Altdorfer's method of combating insomnia is to envelop the body in warm wraps, thus producing peripheral dilatation and cerebral anæmia. In extreme cases we may envelop the body in moist sheets, covered by dry wraps (Becker, Schüller, and others). Such methods act by lowering arterial tension and producing anæmia of the brain. We must remember, however, that, as was pointed out in the last chapter, very low arterial tension will also cause sleeplessness, and in such cases less depressing methods must be adopted.

A light supper is desirable for those who suffer from insomnia, since the introduction of food into the stomach causes a flow of blood to the digestive organs, with concomitant cerebral anæmia (Holland, Durham, Becker, etc.), and in feeble subjects this is often a satisfactory and sufficient method of inducing sleep. It is obvious that such meals should not be copious or formed of indigestible food, for in such a case, digestion being overburdened, and the food tending to accumulate in an undigested form, the phenomena

[1] Broadbent, *Lancet*, April 1887. [2] *Anatomy of Sleep*, 1845, p. 432.

of putrefaction and abnormal fermentation will result, with injurious consequences to health. An overburdened stomach also tends to produce nightmares which more or less disturb the tranquil course of normal sleep. It must also be remembered that the stomach and intestines when full displace the diaphragm upwards, instead of allowing it to maintain a state of relaxation (Mosso). The upward displacement of the diaphragm necessarily diminishes the volume of the lungs; according to Gerhardt, this diminution is equal to 1 cubic centimetre for every 24 centimetres of liquid introduced into the stomach; and Fabius, on the other hand, has shown that the volume of the lungs largely increases in healthy subjects after the use of aperients. The pulmonary or vital capacity has a direct relationship to the question of sleep, for diminution of pulmonary capacity involves a corresponding diminution in the oxidation of the blood—that is to say, in the absorption of oxygen. We have already seen in Chapter I. (p. 8) that various experiments, still unfortunately too few in number, show that there is an exaggerated absorption of oxygen during sleep, the formation, as it were, of a reserve for use during waking life. Diminution of the pulmonary capacity, by more or less limiting the absorption of oxygen by the red blood corpuscles, thus interrupts the regular course of the physiological process during sleep, and the diminution of intra-molecular oxygen necessarily weakens the activity of all the organs and impairs nutrition.

It has long been known that an overburdened digestive canal exerts an injurious influence on the general health, and especially on the psychic con-

dition.[1] Schroeder van der Kolk many years ago showed that it may not only cause a gloomy and melancholy state of mind, but actually lead to serious mental disease. The witty Voltaire alluded to this fact when he remarked that before asking a favour of a minister we should "adroitly ascertain whether his bowels are acting freely." It may also be remarked that, as by relieving the bowels we reduce general arterial tension, we may thus, as Broadbent recommends, often promote sleep by giving an aperient, even if the bowels are already acting regularly.

People who find difficulty in getting to sleep are often aided by attending to monotonous sounds, such as the ticking of a watch beneath the pillow. Uniformity of sounds quickly exhausts consciousness and so induces somnolence; and any monotonous sensation—auditory, visual, or tactile—may act in the same way.[2]

The Influence of Light, Air, etc.—Those who are inclined to excessive sleep should have no curtains to the windows of their bed-rooms, so that the light of day may have free access, and prepare the sleeper to

[1] From observation of many subjects of different ages I have become convinced that while late dinners and suppers are injurious to all, they are especially so to those with diseased livers. Probably the most natural time for a substantial meal is between 12 and 3 o'clock.

[2] Southey, in *The Doctor*, thus summarises some of the chief devices to attain sleep by monotony: "I listened to the river and to the ticking of my watch; I thought of all sleepy sounds and of all soporific things—the flow of water, the humming of bees, the motion of a boat, the waving of a field of corn, the nodding of a mandarin's head on the chimney-piece, a horse in a mill, the opera, Mr. Humdrum's conversations, Mr. Proser's poems, Mr. Laxative's speeches, Mr. Lengthy's sermons. I tried the device of my own childhood, and fancied that the bed rushed with me round and round. At length Morpheus

awake by a series of preliminary sensations; for, as Mosso has shown, a ray of light falling on a sleeper's eyelids stimulates activity in the nervous centres and increases the blood-supply of the brain. Those, on the contrary, who are subject to insomnia should have curtains to all the windows, for, in consequence of the excessive excitability of their nervous systems, even a feeble ray of light may easily awaken them too early, before the processes of sleep are accomplished.

To understand the enormous influence which light exerts on the organism it is sufficient to remember that in darkness, during the waking state, we eliminate much less carbonic acid than in daylight, as Fubini and Ronchi have shown. The same phenomenon has been observed in animals by Moleschott, Platen, Selmi, and Piacentini, so that we are here in presence of a general law.

A special interest attaches to those experiments in which the animals were not shut up in the dark, but merely prevented from seeing the light; it was found that if the eyelids were merely closed by diachylon plaster there was some alteration in the respiratory

reminded me of Dr. Torpedo's Divinity Lectures, where the voice, the manner, the matter, even the very atmosphere and the streaming candle-light, were all alike soporific; when he who, by strong effort, lifted up his head and forced open the reluctant eyes never failed to see all around him asleep. Lettuces, cowslip wine, poppy syrup, mandragora, hop pillows, spider's web pills, and the whole tribe of narcotics, up to bang and the black drop, would have failed—but this was irresistible; and thus, twenty years after date, I found benefit from having attended the course." (The insomnia from which Southey himself suffered as a result of close and affectionate attendance upon his sick wife, is said to have been the starting-point of his subsequent insanity.) Reference may also be made to Wordsworth's well-known sonnet: "A flock of sheep that leisurely pass by," etc.

changes (Platen). Dewar found by direct observation that under the influence of light on the eye the energy of the brain underwent remarkable modification; and the great importance of light for the tissues is further shown by the observations regarding the effects of electric light in relieving pain (Stein, Netchaieff). The importance of light for the conscious intellectual life is so great that, as Purkinje pointed out many years ago, a better illumination of our houses by windows and good illuminants, and a perfected system of street lighting, should distinctly favour the growth of social life. Light not only drives away sleepiness but increases the general activity and enlarges the sum-total of consciousness. In the extreme north, with its endless night, psychic life attains a very low degree of development;[1] and a distinguished observer (Johannes Müller) has remarked that in darkness we can never be so witty and intelligent as in the light. This is evident when we remember that darkness, especially when combined with silence, deprives us of our habitual sensations due to stimuli from the external world, leaving the world of reflex acts to predominate. The chief surgeon to the great works at Cyfarthfa, in Wales,

[1] "The darkness at midday at Conger was such," says Greely, "for nearly two months in mid-winter, that the time could not be told from a watch held up with its face to the south. At Fort Conger stars were to be seen at local noon seven days after the sun had gone for the winter, and so remained visible in a cloudless sky for over four months." The effects of this darkness on the spirits and temper of the men are particularly noticed; in some it produced insomnia, indisposition to exertion, and in all, irritability of temper. The effect upon Greely himself is thus described: "In my own case, although following a set routine, it was only with difficulty that I could limit my sleeping hours to a reasonable number, or apply myself steadily and successfully to mental work. While free from mental depression, insomnia,

assured Dr. Macfarlane that miners injured in the darkness suffer more from shock than those injured in the light. Schopenhauer says that darkness and the hour of midnight only make us afraid when we are alone; society and light cause us to forget that midnight is the hour of apparitions and ghosts, and he concludes that in reality it is ourselves that we fear in darkness, our own ideas and the play of our sensory organs. A similar remark was made by Dugald Stewart. But in analysing the fear that seizes men in darkness and the gloomy silence of night, it must not be forgotten that under these circumstances the excitations from the outer world are reduced to a minimum, and the cerebral mechanism is in a state of temporary repose; we are predisposed to the play of fancy, to the apparition of various images in the field of vision and of consciousness, as it were both to central and peripheral hallucinations; and in many cases this process is aided by dreams. This is well shown by Professor Stanley Hall in his elaborate study of fears. Of some forty cases of fear of darkness which he brings forward, about thirty contain references to bears, tigers, and fantastic monsters; no doubt such visions played a part in

and feelings of lassitude which characterised some, yet I was at times affected by irritability of temper, which it required a continual mental struggle to repress" (A. W. Greely, *Three Years of Arctic Service*, 1886, vol. i. p. 155). The faces of all acquired a pale yellowish-green colour. The sun was absent from October 15th to February 25th, but ten days after the sun had disappeared a brilliant mock-sun was seen. It is remarked that notwithstanding the darkness which has been described, it was only on a few stormy days that it was too dark to take regular exercise, and in addition to the light of the moon and stars, the snow appeared to give out a faint phosphorescent light. The effect of the darkness on the Eskimo was even greater than on the rest of the party.

even a larger proportion of the cases. Probably there are very few persons who have not experienced this fear of darkness at some period in their lives. Stanley Hall traces the development of this fear in the tendency of children to strain their eyes into the growing dark of twilight which threatens to swallow them like a monster; in the projection outwards of the processes going on within the eyes; in the visual images, often not very remote from after-images, seen in bed, on the canvas of darkness; in the spasmodic startings on first falling asleep, and the feeling of terror which accompanies them.[1]

Having decided on the measure of light which is desirable in cases of abnormal excess or defect of sleep, it may be asked whether in cases of normal sleep the windows of the bedroom should be darkened by curtains. We must be guided by circumstances in this respect. If the windows have a north or west aspect—that is to say, if they are so placed that no

[1] G. Stanley Hall, "A Study of Fears," *Am. Journ. of Psych.*, 1897, pp. 183-189. Professor Hall makes the following suggestive observations on this subject:—"Children who gloat over horrors may be instinctively applying strong stimuli to develop the rude, early stages of imagination, as we pinch ourselves to keep awake. . . . It is in those drifting automatic states so favoured by darkness, and sometimes even by fatigue, when the imagination is laying the basis of mind and first divorcing thought from sense, that the soul feels the pain of its old scars received in the long struggle by which intelligence unfolded out of instinct and instinct out of reflexes. In the past the pain field has been incalculably larger than the pleasure field, and so potent is this past that its influence dominates the most guarded child, in whom otherwise the pleasure field should be relatively the largest anywhere to be found. Now, darkness and the unknown alike have few terrors; once they had little else. The old night of ignorance, mother of fears, still rules our nerves and pulses in the dark, despite our better knowledge. Lacking this latter, children fall still more abjectly under her spell. Hence it is that animals found only in distant lands or long

direct morning sunlight can enter—it is best to leave them without curtains, or using only white blinds of calico or similar material when the demands of propriety make it desirable to mask the windows. If the windows face the east, similar blinds will preserve the sight from the rays of the rising sun when the period for awakening arrives.

Since we are now occupied with the bedroom it may be as well to add all that remains to be said on this subject. A good bedroom should be spacious, since we need much fresh air when sleeping. Active ventilation is not less necessary; it is evident that ventilation must be so arranged as to avoid currents of cold air, since the skin during sleep, in consequence of the increased perspiration, is very sensitive to cold, and we are more easily chilled asleep than awake (Sorgewohl). To increase the supply of fresh air, the room should not be encumbered with furniture and draperies. The bed should be placed near the inner wall, as far as possible from the windows and the

extinct, impossible monsters, ghosts, etc., rarely present, and never feared in waking consciousness, bear witness again to the remoteness of the past to which some of the roots of this class of fears penetrate." (And see also Sully on the causes of the fear of darkness in childhood, *Studies of Childhood*, 1896, pp. 211-219.) The same effects are produced by darkness in nervous disease. "The darkness of the night," remarks Dr. Macfarlane, "reduces many a neurasthenic to the mental level of a child or a savage. In darkness they are haunted by fears unknown to their daily lives. It has been noted that in the insane (*Lancet*, 11th April 1891) thoughts grow far more extravagant in darkness; indeed, a form of nocturnal insanity is well recognised, characterised by restlessness and excitement, and by an extravagant mental state, symptoms which completely disappear during the day. Some patients have curious hallucinations whenever they shut their eyes. One that seems to be disagreeable is a loss of the sense of locality; they think their bed is placed in a different position, etc."

fireplace, in order to avoid the currents of air which are always strongest at these spots. The temperature of the room in which healthy people sleep should always be cool, about 58° or 60° Fahr. Children during the early years of life need a warmer temperature. During the early days after birth this temperature should be between 75° and 76° Fahr.; at the end of the first month it should be lowered to 74°-72° Fahr.; at the end of the second to 70°-68° Fahr.; at the end of the first year to 66°-64° Fahr.; and in the fourth year children may sleep in a temperature of 64°-60° Fahr.

It is easy to discover by experience that a night spent in a room that is too hot never gives the sensation of freshness and comfort that is felt in a cool room. On the contrary, we rise with a feeling of heaviness in the head, a sensation of fatigue throughout the body, the face a little swollen, and the eyelids puffy. This is not surprising, for the heat of the room increases the perspiration developed during normal sleep; it is as if we had taken a hot-air bath—with this difference, that such a bath never lasts so long as normal sleep. The increased and prolonged cutaneous activity may provoke a slight serous transudation and swelling of the skin. It is evident that this will inevitably cause fatigue, and, which is worse, enfeeble the cutaneous vessels and weaken their normal tone, reacting on the vasomotor sphere which plays so important a part in the normal course of physical and psychic life. As a rule, swelling of the face or eyelids on awakening is a sure index that the conditions of sleep have not been normal; either sleep has been excessive, or the temperature of the room was too high, or the air

was not pure. If for any reason it is necessary to sleep in an excessively hot room, we should diminish the time given up to sleep. As a rule, the higher the temperature of the room, the less we ought to sleep. For this reason we should sleep less in summer than in winter, and less in the south than in the north.

To show that the influence of heat may in more than one respect reinforce the phenomena that accompany sleep, we may push the analysis of this question still further. It is well known that under the influence of heat the peripheral vessels dilate and are gorged with blood, and that there is simultaneously a relative anæmia of the internal organs, including the brain. Sleep acts in the same direction. On the other hand, it is known that heat weakens the tone of the different tissues. Exactly the same result is produced by prolonged sleep. This explains why nasal and other hæmorrhages have a tendency to appear both during sleep and under the influence of heat, since in both cases the tone of the vessel walls is diminished, and rupture is easier, being still further favoured by the accompanying dilatation from engorgement. For the sake of health, therefore, it is necessary either to maintain a cool temperature in our bedrooms or to diminish the amount of sleep. It may indeed be observed that we have a tendency to awake early in a room that is too hot, and that sleep under these conditions is heavier.

Leaving the question of temperature, we may now turn to that of impure air. We know that there is normally an accumulation of carbonic acid during sleep, less being eliminated than during waking life. At the same time, as we have already seen, there is an increased absorption of oxygen. If, therefore, the

air of the bedroom is not sufficiently renewed, and the oxygen is more or less exhausted while the carbonic acid accumulates, the sleeper, at each inspiration, receives too little of the former and too much of the latter. According to Santorini, during sleep we eliminate twice as much vapour as when awake; while Voit's observations on man have shown that when the temperature of the room is below 14°-13° C. the elimination of carbonic acid increases, while other experiments, on cats, have shown that fresh air contributes to the elimination of carbonic acid and the absorption of oxygen, while heat increases the loss in the form of vapour.

Thus there can be no doubt that the air of the bedroom should be as cool and pure as possible, while the bed-clothes should never be put over the mouth, thus leading to repeated breathing of the same air. The head and neck should be uncovered, while the lower part of the body should be carefully covered, especially in those who are inclined to insomnia, since cold feet tend to prevent sleep.

Position during Sleep.—It is desirable that we should accustom ourselves to changes of position during sleep. Dr. Osborne, who investigated the most favourable position for sleep at various ages of life, found that children under fourteen sleep equally on the left side, the right side, and the back; but that young girls and youths from fourteen to twenty years of age sleep most often on the right side (59 cases), then on the back (29), more rarely on the left side (23).[1] Similar observations on soldiers have shown that they sleep more often on

[1] Osborne, *Dublin Quarterly Journal of Medical Science*, 1859, *vol. xxviii.*

the right than on the left side. On the other hand, Pettetan, Andral, and others have remarked that inflammation of the right lung is more common than is that of the left lung; the predominance of the former is as 2.5 to 1; or, according to Andral, as 2 to 1. By many this fact is attributed to sleeping on the right side, since, by the influence of gravity, a passive stasis of blood and lymph thus occurs in the right lung as well as in the liver. In the same way we may explain the greater frequency of inflammation at the basis rather than at the apex of the lung by the vertical position during the day-time. The vertical position also predisposes to other disturbances, such as varicose veins, affections of the womb, hæmorrhoids, etc. In order to avoid such injurious stases of blood, some authors even recommend that during the day we should vary the position of the body by reclining, lying down, etc., instead of always sitting or standing. And if the uniform position of the body is injurious even during waking life, it is much more so during sleep, when there is already a tendency to the formation of stasis and diminished tone of the tissues.

The influence of the position of the body on the vasomotor sphere is shown by the change in the pulse, which may fall from 85 in the standing position to 76 when seated, and 68 when lying down; Mosso's balance also shows that during waking life there is a more or less pronounced stasis of blood in the feet and the lower part of the body, and that this phenomenon is the more pronounced the more anæmic and exhausted the tissues are. In feeble and anæmic persons, whose vessel walls have lost their normal tone, we may often observe pains in the

back on awakening in the morning. These pains are in many cases due to the habit of sleeping on the back. The same habit may cause nightmare, for if the stomach, when full of food, rests on the descending aorta, there is an abnormal flow of blood to the brain through the ascending aorta (Osborne).

My own observations lead me to believe that to maintain the regular nutrition of all the tissues and organs of the body it is important to change the position of the body as often as possible during sleep, and to take advantage of each awakening during the night to sleep in turn on the right side, the left side, and the back, while every morning, for at least half-an-hour before rising, it is good to lie on the stomach. At first this position may seem uncomfortable, but it is not difficult to become so accustomed to it as even to be able to sleep in this position. During the last five or six years I have collected over twenty observations concerning the favourable effects of this position in anæmic subjects who complained of severe pain in the back. I have also several times had an opportunity of observing that this position, if taken every day, exercises a salutary influence on angina pectoris; the painful attacks of asthma and præcordial anguish diminish and almost disappear. This beneficial influence can only be explained by a more regular distribution of blood and lymph, and consequently a more normal nutrition of the cardiac muscle, as well as by the dissipation of passive stases in the tissues and organs of the back and sides. In little children we may observe a marked tendency to sleep in this position, flat on the belly, but they are broken of it, evidently from the fear that they might acquire bad *habits.* I have myself heard nursemaids frightening

children by saying that if they slept like that it would do them harm, or be a sign that their father or mother would die. It is therefore not surprising that we have nearly all lost the habit of thus lying with the face beneath, and that we are obliged to learn it afresh, consciously. Animals are free from the various disorders and diseases to which I have just referred, and one cannot avoid asking how much such disturbances of health are due to the proud erect position which man alone among animals has adopted.

Thus position during sleep is by no means a matter of indifference. On the contrary, to some extent health depends upon it. With the exception of those who suffer from undue flow of blood to the brain, and who should have the head raised high on the pillow, we should assume a nearly horizontal position, and become accustomed from childhood to sleep by turns on the right and left sides, the back, and the belly.

We have already, in dealing with insomnia, had occasion to note the harmful results of brief, interrupted periods of sleep. It may not be out of place here to refer to the case of those who are nursing the sick, and are specially liable to fall into such habits of sleep. Every one who is watching an invalid ought to be able to sleep for at least two or three hours at a time, in order to pass the period of deepest sleep and avoid any interruption of the normal process of repair. It often happens that those occupied in the care of persons who were seriously ill have themselves fallen ill, evidently because sleep was so broken and so short that the brain was unable to obtain normal rest. It must be remembered that sleep is accompanied by contraction of the vessels of the brain, and repeated awakening at

the commencement of sleep must lead to dilatation in place of contraction, and eventually to a serious disturbance of vascular tone, since such useless alternation of contraction and dilatation weakens the vessel walls. A brief sleep is insufficient to nourish the brain, and the dilatation of the vessels on awakening remains ineffective. Meynert's investigations have shown that mental diseases usually begin in derangement of the vascular system; indeed, all the different states of the organism, the functions of the different organs, the contractions of the muscles, the play of emotion and thought, depend necessarily on the changes in the volume of the vessels, and in their fulness; consequently any perturbation in the vaso-motor system is shown in chemical and histological modifications of the vessel walls, which, again, become the point of departure of further more serious mischief. So that even when we are forced to sleep very little we should still reserve three or four hours of continuous sleep.

The Hours of Rising and Going to Bed.—The current opinion has long been expressed in the proverb: Early to bed and early to rise. This opinion, combined with the wish of grown-up persons to arrange their evenings as freely and quietly as possible, has led to the wide-spread custom of sending children to bed at a very early hour. It is evident that children who are sent to bed at seven or eight o'clock in the evening ought to get up at six or seven in the morning, and as the parents, who went to bed much later, are then still asleep, the children frequently have to begin life every morning under the care of servants. This in itself is not always a desirable circumstance, especially when we remember that the servants themselves at this early

hour are often half asleep, unwashed, and dishevelled. Moreover, during the winter months, it is still dark at seven o'clock in the morning. No doubt it is well to rise early, but only when we awake to meet the light of day, not in the darkness of night, which, as we have already seen, has an injurious influence on metabolism. It seems desirable, therefore, that in autumn and winter children should not be forced to rise at an hour when the sun himself has not yet risen; it would be better for them to go to bed at nine or ten, so that they can get up when their rooms are already lit up by daylight, or even by the rays of the sun.

Equally injurious and unwholesome is the custom of forcing school-children to get up by artificial light. As a rule it would be better to conform more closely to the conditions of nature, and to rise very early in the spring and summer, late in the autumn and winter. In southern countries, naturally, it is thus possible to rise early even in the autumn and winter. In this way northern peoples would sleep longer than the inhabitants of southern countries, which is reasonable, since a cold temperature increases the need for sleep. I have found that when the temperature of the room is from 66° to 68° Fahr. many people feel perfectly refreshed after six to eight hours of sleep; at 60°–64° Fahr. the same persons slept eight or ten hours; at 52°–56° Fahr. ten to twelve hours; while when the temperature of the room was raised to 70°–76° Fahr. they could only sleep from three to five hours. This relation between the surrounding temperature and the duration of sleep—a relation which is constant in subjects with a normal vascular system —undergoes change in some old people who cannot

sleep in rooms of which the temperature is below 70° or 74° Fahr. In such cases the vascular walls are degenerated and less flexible and dilatable, so that a higher temperature of the surrounding air is necessary to enable the surface vessels to receive a larger quantity of blood.

Returning to the question concerning the best hour to rise, I may point out that those persons who get up very early in the autumn or winter never look fresh and cheerful, but, on the contrary, sour and fatigued; they give the impression that they have not been refreshed by sleep, and that they have not risen of their own accord. Little children who get up early in winter begin the day with tears and whines, while in summer their awakening is accompanied by joyous bursts of laughter. We have indeed all experienced the unpleasant feeling of rising in the dark or when daylight is still struggling with darkness, and the general experience of such sensations, together with various theoretical considerations—in the unfortunate absence of direct proof—may justify us in concluding that it is good to rise early, but only when the morning is light and sunny as in spring and summer, and not when it is dark, damp, and cold, as in autumn and winter. Light plays so important a part in mental life that consciousness on awaking from its periods of repose should be able to expand in its brightness, and children and growing young people should not be forced to begin every day of their life, during autumn and winter, with a series of painful or unpleasant sensations.

Such considerations are not trivial, for we do not know what effects may follow causes even as slight as *these*. Alexander von Humboldt pointed out that the

most insignificant circumstances, and even the sensations received by the different senses, may ultimately modify the whole character, and change the direction of life, if these influences fall on a young growing organism.[1] We know also that physical development is quite different in southern countries, full of light and sun, from what it is in the dark and frozen lands of the far north (Rattray). Unfortunately detailed investigations are still wanting, though the desirability of observing the progress of different physiological processes and different diseases in countries of the extreme north, where night lasts for several months without interruption, has been pointed out by various authors (Potain, etc.). It cannot be doubtful, however, that while in autumn and winter it is good to rise and to go to bed later, in spring and summer we should rise early, at five or six in the morning, when we can plunge into an ocean of light. We owe everything to light; without it life is impossible; it is light that we are searching for all our lives everywhere and in everything, and it is natural that we should so act as to awaken every day in the midst of light and not of darkness. It is unnecessary to add that the habit of people in society of going to bed when day is dawning and rising at mid-day, or even later, is extremely hurtful. As a general rule it is well to go to sleep at no later hour than eleven, though the contemporary life of great cities is so organised that it is often very difficult to carry out this hygienic rule.

[1] Féré has dealt with the subtle influence exerted by varying sensations on muscular movement; he found, however, that the dynamogenic enfeeblement due to darkness is less marked than might be supposed. (*Sensation et Mouvement*, p. 47.)

The bed should be exposed to the air and the sunlight at all seasons of the year. This is obviously desirable, since pillows and mattresses become impregnated with the exhalations of the skin, which is especially active during sleep. The bed itself should neither be too soft nor too hard; the most hygienic is the spring bed with hair mattress. Feather beds should be abolished, except when it is specially necessary to guarantee the sleeper against cold.

Many people have acquired the bad habit of breathing through the mouth instead of through the nose;[1] it is a highly injurious habit and predisposes to affections of the throat as well as of the lungs; moreover, it dries the mouth and pharynx, and during sleep this sensation of dryness may bring on a fit of coughing or other of those series of reflex phenomena to which sleepers are specially exposed.

Starting and Distressed Awakening.—Dreams of Flying.—In dealing with the hygiene of sleep we cannot neglect two closely allied groups of phenomena, the starting or "jumping" which always takes place, when it occurs, on falling asleep, and the distressed awakenings which occur in the early morning. The latter are more distinctly morbid, so that they do not much concern us here. They are largely due to nervous exhaustion and to auto-intoxication by the products of digestion and metabolism; and are common in neurotic subjects, in neurasthenia, epilepsy, and hysteria, as well as during pregnancy and at the menopause, occurring chiefly in

[1] Dr. Walters, by observation of 1007 persons at random in the streets of London (and disregarding those persons whose mouths were open in talking or for other adequate reason), found that not fewer than 553, or nearly 55 per cent., had their mouth open. (*Brit. Med. Journal*, 26th June 1897.)

those who have reached middle age, and with about equal frequency in men and women. The symptoms can be largely relieved by those hygienic measures already discussed, which stimulate and restore the nervous energy (bright light, for instance, shortens and decreases the acuteness of the attacks), and by dietetic and other methods calculated to lead to the excretion of waste products.[1]

The phenomenon of starting, or "jumping," or

[1] Dr. Macfarlane has specially studied this condition, and I may quote some of his remarks:—"The patients to whom I wish to refer are a class of habitually bad sleepers, who awake every morning more or less wearied and worn out, but who also from time to time, after an unusually deep sleep, awake in great misery. Collectively, they present very similar symptoms, although these may be modified to some extent by temperament and mental development—in short, by the quality of the man. They awake in the early morning, usually from four to five o'clock, in much distress, covered with cold perspiration, and they lie tortured by evil forebodings for an indefinite time. The mental distress usually begins before sleep terminates; they are conscious that it awakens them, and occasionally they find themselves groaning. They do not recollect that the sensation had its origin in a terrifying dream, nor do they associate the awakening with dreaming. The acute misery is followed by depression and dread. They attribute the awakenings to sleeping 'too deeply,' and these bear an intimate relation to morbid sleep. Two patients who are so afflicted state that they occasionally awake not knowing who they are, or where they are, and without knowing that they have slept until they find out how many hours have passed; the mental unrest follows. They all agree that the seizures, if they may be so called, are more prostrating than lying awake all night. Such awakenings do not recur with regularity, although in one instance they did so every seventh or eighth night for a time. The patients who suffer in this way are invariably neurotic and neurasthenic; some are hypochondriacal. They present widely different symptoms during the day, but they all exhibit, in greater or less degree, a lack of mental power and endurance, and they are introspective, self-conscious, and desponding. They dread the unknown; frequently they are restless, and yawn and sigh a good deal." —A. W. Macfarlane, "Note on Distressing Awakenings," *Lancet*, 11th April 1891.

"psychic decapitation" (from its analogy to the movements of beheaded animals), or "sensory shock" (Weir Mitchell[1]), occurs only on falling asleep, is common in the young, and is a less distinctly morbid condition. It always indicates, however, some slight degree of nervous exhaustion; it is the convulsive and irregular action of the lower centres relieved from cerebral control; and in neurasthenic and hysterical subjects, and in all those who are victims of excess, as of tobacco, it is specially marked. It is common, if not indeed normal, in children, and its resemblance to the shock of sudden fear in presence of danger, and the terror that it may consequently arouse in a child's mind, have suggested to Stanley Hall that it is a factor in constituting the fear of darkness.[2]

These startings on falling asleep, followed by sudden awakening and sense of fear, are frequently associated with the sensation of falling. It is not easy at present to explain this association. It seems probably due to the fact that, from lulling of consciousness, the subject ceases to feel the contact of the bed, and experiences the illusion that he is unsupported—that is to say, that he is in the air—and thus he dreams that he is falling. Added to this, we must bear in mind that children have ample occasion to familiarise themselves with the sensations of falls, and, as I have pointed out, those startings and dreams of falling or flying are specially common in children and the

[1] Weir Mitchell, "Some Disorders of Sleep," *Am. Jour. Med. Sci.*, vol. c., pp. 120-123. These "sensory shocks," however, include only the sudden jars and explosions which occur within the head at this time, more especially in cases of great nervous exhaustion.

[2] "A Study of Fears," *Am. Journ. Psych.*, 1897, p. 188.

adolescent of both sexes who are much inclined to deep sleep.[1]

This explanation is supported by the well-known fact that at the moment of fainting the feeling of slowly falling into space is frequently experienced. At such a moment the nerves at the surface of the body are more or less deadened by the enfeeblement of consciousness. Under the influence of many narcotics, also, such as opium, ether, and haschisch, the sensibility of the cutaneous nerves and the muscular sense is likewise deadened, and the subject imagines himself to be flying or falling in the air, without touching the floor. The sensations of falling and flying experienced in dreams may thus be regarded

[1] Professor Stanley Hall independently suggests a somewhat similar origin for the dreams of falling or flying, especially invoking the actual absence of the accustomed pressure felt on the soles of the feet and elsewhere in the standing position or in the sitting position during waking life. He also finds here a very ancient atavistic element:—"Our animal ancestors were not birds, and we cannot inherit sensations of flying, but they floated and swam for longer than they have had legs, had a radically different mode of breathing, and why may there not be vestigial traces of this in the soul, as there are of gill-slits under the skin of our necks? And why may not the former come to as great prominence in exceptional states and persons as the latter do in some monstrous births? To deny it is to make the soul more limited in its backward range than is the body. For one I am too idealistic, and cannot think so meanly of the soul as to do this. Although it cannot be demonstrated like rudimentary organs, I feel strongly that we have before us here some of the oldest elements of psychic life, some faint reminiscent atavistic echo from the primeval sea, not as primitive as the strange geotropism of plants, but antedating perhaps limbs, and possibly even visual factors of space perception. To me," he adds, "sensations of hovering, gliding by an inner impulse rather than by limbs, falling and rising, have been from boyhood very real both sleeping and waking, and I may add with assured soundness of heart, lungs, and stomach, although if caused by disease it would not hurt the argument."—*Study of Fear*, pp. 158, 159.

as directly related to the deadening of the sensations normally felt during sleep at the surface of the body.[1]

The Influence of Sleep in Disease.—We have seen that the sleep produced by narcotic or hypnotic drugs is not usually a normal sleep (p. 87), and that when such drugs are prescribed in cases of insomnia it is largely in order to break a bad habit or to prevent its formation. They are, however, also useful in another way, for the sleep they cause is often transformed into normal sleep after the narcotic has been eliminated from the blood and its influence dissipated. This is a very desirable event, for in a number of diseases sleep, as has often been shown, is the best of medicines.

For this reason people who are seriously ill, when once they have fallen into a normal sleep, should never be awakened to take their medicine, for medicine can never give what is given by normal sleep and its processes of plastic nutrition. Every doctor is glad to see the appearance of deep normal sleep in patients who are seriously ill, for such sleep is often decisive and marks the commencement of convalescence.[2]

In this matter, however, as in others, the rule is not without exceptions, and under some circumstances sleep may produce an injurious influence on pathological processes. Thus in some cases of very

[1] Sir William Gowers considers that there is some evidence to show that the sensation of falling during sleep is caused by spontaneous contraction of the stapedius muscle in the ear. (*Brit. Med. Jour.*, 14th November 1896.)

[2] Menander said that all diseases are curable by sleep, "a broad statement," as the late Sir B. W. Richardson remarked, "in which, nevertheless, there may be something that is true, for good sleepers *are ever*, as I think, the most curable patients."

marked weakness of the heart it is possible for the patient to sleep too long, regular administration of cardiac tonics being essential, and on awaking such patients must be lifted into the sitting posture only with much precaution. Unfortunately, the influence of sleep on various morbid states is at present insufficiently explored; there is no doubt that it varies under varying pathological conditions. We know, for instance, that sleep predisposes to hæmorrhages (Becker); this is found to be the case, for instance, in pulmonary tuberculosis, in piles, and in uterine disorders, and is the result of more or less dilatation of the vessels. Sleep also predisposes to attacks of gout in those who have the gouty diathesis. Profound and prolonged sleep is injurious to those who are subject to convulsive disorders, such as epilepsy, for, as we know, sleep abolishes consciousness and temporarily transforms man into a reflex and spinal animal, consequently exposing him to convulsive attacks; thus often in children and in some adults there is spasmodic incontinence of the bladder during sleep but not during the day. But, I repeat, these questions are still insufficiently explored; we do not yet know how, and how much, the subjects of various diseases ought to sleep.

Thus, to take an example, the phthisical suffer greatly from excessive nocturnal sweats, and in medical literature we may find many methods for diminishing these sweats. But the very multiplicity of the methods proposed shows that they do not accomplish their aim. The tendency of consumptives to excessive and exhaustive sweats may easily be understood when we realise that the accumulation of carbonic acid in the organism must irritate the

sweat centre and so provoke abundant perspiration. We know that during sleep, even in normal subjects, carbonic acid accumulates in the organism; in the phthisical this accumulation must be greater, for, as Lauder Brunton points out, the respiratory centre in these subjects is exhausted by much coughing, so that the carbonic acid can no longer excite it to greater activity.

Theoretical considerations, on the one hand, and observation of patients on the other, lead to the conclusion that those exhausting sweats of the phthisical are less marked when the patients take a light meal before going to bed; and this is natural, since food causes the blood to flow towards the stomach and diminishes the dilatation of the peripheral vessels of the skin. I have observed, also, that these exhausting sweats are completely absent, or much diminished, when the patient sleeps during the day-time and in the day-light. The light of a lamp seems also to diminish the tendency, provided it is not allowed to vitiate the air of the room. Pure air is especially necessary for consumptives, as in these the functional energy of the lungs is diminished and the consequent defect of oxygenation must be compensated by a larger amount of oxygen in each respiration. The bedroom of the phthisical must be cool and saturated with pure air.

Those who suffer from neuroses of the heart, or other cardiac affections, need to remain in bed for a considerable time—at least eight or ten hours—in the horizontal position, every day, since the quiet of bed and the horizontal position alone give the heart repose and dispel the tendency to œdema of the feet which is found in such cases. There is another

reason why these subjects should not rise too early: in the early morning hours, between four and eight o'clock, they show a special tendency to cardiac attacks. At this period there seems to be a special state of cerebral anæmia and a general tendency to depression. The distressed awakenings, already spoken of, and the termination of many kinds of morbid sleep occur at this hour. Between four o'clock and eight also is the period of greatest mortality; or, according to Watson and Finlayson, the curve reaches its height between 5 and 6 A.M. According to Schneider's observations at Berlin, between 4 and 7 A.M.[1] The results are recorded in the following table:—

PROPORTION OF DEATHS PER 1000.

	Deaths.	A.M.			P.M.		
		12–4	4–8	8–12 (noon)	12–4	4–8	8–12
Watson and Finlayson .	13,854	159	180	174	162	166	159
Schneider	57,984	169	191	169	152	163	157

[1] *Glasgow Medical Journal*, New Series, vol. vi., p. 171; Virchow's *Archiv.*, Bd. xvi., p. 95; *British Med. Journal*, 26th Sept. 1896. Beadles (*Brit. Med. Journal*, 7th Nov. 1896), from the investigation of the hour of death of nearly 3500 male and 1000 female inmates of the Colney Hatch Lunatic Asylum, found that among the males there was a very marked increase of deaths at from 5 to 7 A.M., but no such increase among the females, who showed a more even curve with a slight tendency to rise before noon, and again between 7 and 8 P.M. These asylum figures were probably recorded with accuracy. It may be noted that the usual cause of death was exhaustion, and that the average age of the females was much greater than that of the males.

Moreover, the observations of Mönninghoff and Peisbergen have shown that in healthy subjects, while the culminating point of sleep is reached in the last quarter of the second hour, it decreases in depth up to four hours and a half; there is then a deepening of sleep, and at the end of five hours and a half a second maximum of depth is reached, after which there is progressive diminution until definite awakening occurs. This second maximum of sleep intensity, which seems connected with the appearance of dawn, may often be observed empirically, especially by those who have passed a restless night. It seems to be the time of maximum somnolence. Many years ago, a famous physician, Dr. Graves, wrote: "It is between three and five in the morning that the inclination to sleep is strongest; it is about this time that sentinels are most apt to slumber at their posts, and consequently, attacks upon camps or cities, made with the intention of effecting a surprise, are usually undertaken at this period of the morning." Patrick and Gilbert, in their experiments on the effects of abstinence from sleep (already referred to in Chapter I.), found that the time of dawn is always the period of greatest sleepiness.

While this is the normal course of sleep in healthy subjects, in a man who was suffering from mitral insufficiency of the heart the first maximum of sleep appeared later; and, moreover, sleep became accentuated three times instead of twice, and presented more considerable variations than in the normal subject.[1] Unfortunately, these observations are still unique; there is a pressing necessity to study not only the sleep of normal persons, but also the various

[1] Mönninghoff and Peisbergen, *Zeitschrift für Biologie*, 1883.

changes in the character of sleep produced under the influence of various chronic and acute diseases. It is certain that sleep must be modified by disease, for consciousness is so affected, and sleep is but the resting-time of consciousness. We may find evidence of this in the fact that sleep becomes irregular and restless in those who smoke more than usual, and that alcohol modifies the character of the sleep. All the influences which act upon consciousness must necessarily be shared by sleep.

From various observations which I have lately made, I believe that I am justified in concluding that sleep decreases steadily at sunrise; and thus, as every period of awakening is followed by deeper sleep, it happens that we sleep very soundly during the first hours of light, whence the well-known satisfaction felt in such sleep. Mother Nature awakes the whole organic world when each new day begins to dawn, but if we remain deaf to her appeal and endeavour by means of blinds and shutters to prolong artificially the reign of nocturnal darkness and the repose of unconscious life, then the general law—that an incomplete awakening is followed by deeper drowsiness—comes into action, and consciousness falls gladly back into its part of the Sleeping Beauty of the fairy-tale.

The Hypnagogic State.—Before concluding this chapter it may be well to speak of the half-waking or hypnagogic state which occurs in some persons at the moment when they awake, and for a few seconds or even minutes prevents them from gaining full consciousness, or from understanding where they are or what they have to do. Such a state, if prolonged, always indicates a certain feebleness and inertia of

consciousness and its anatomical substratum, and consequently it is not of good augury. Cases may be found in medical literature (Schnittmüller, Brierre de Boismont) in which this half-waking state preceded the development of mental disease, of which it was, so to speak, the precursor. This is not surprising, for when the nervous balance is ill-established the most insignificant cause may provoke a dissolution in the grouping of cerebro-nervous elements. Thus there are cases (Dickson) in which, after only once being put under the influence of chloroform, a state of complete dementia has supervened.

It is unnecessary to add that since the prolongation of the half-waking state indicates peculiar weakness of consciousness, it is not found in persons whose conscious cerebral activity is highly developed, or, if it is found, it is not a good symptom.[1] From observations which I have collected, it appears that among 100 cases of this state, 8 were found among subjects occupied in severe intellectual work, 70 in people whose work involved much exercise of the arms and feet, and 22 in people occupied as merchants, artists, officials, etc. It may be added that the half-waking state occurs especially in stout, phlegmatic, and plethoric individuals, and very rarely in nervous and sanguine persons.

This state of half-awakening has been studied by Baillarger and Maury, and they called it "the intermediate state between sleeping and waking, or the hypnagogic state." They acknowledged a

[1] It has lately been suggested that there is a connection between the hypnagogic state and that disturbance of memory, often associated with exhaustion, commonly called paramnesia. (H. Ellis, "A Note on *Hypnagogic* Paramnesia," *Mind*, April 1897.)

certain relation between this state of half-awakening and different states of mental aberration, which cannot astonish us, as we have seen already that intellectual pursuits lessen the frequency of this peculiar state; and on the other side we have seen that this state of half-awakening denotes always a weakened state of consciousness. It is therefore of interest to find out what physical and physiological peculiarities underlie it. As we know already, normal sleep is always accompanied by a temporary anæmia of the brain, consequent on an enforced flow of the blood from the head to the skin and other organs of our body; it is only natural to suppose that this state of half-awakening is observed only in cases when the vasomotor system shows an exceptional feebleness of tonus; that is, when the blood-vessels, after being contracted during sleep, cannot dilate quickly enough at the moment of an awakening that comes much too early and too abruptly. In consequence of this slowness of dilatation, the blood-vessels of the awakened person remain during a certain time contracted and the brain more or less anæmic. And so it comes to pass that the awakened person continues to remain in a state of half-sleep, of half-consciousness, during which he sees, hears and perceives everything; but cannot give an account of all this, cannot, in short, form a judgment of anything. In other words, a person in this state of half-awakening perceives everything in the phenomenal world around us by the laws of space and of time; but, at the same time, the law of causality, or of the sufficient cause (Schopenhauer), remains in a state of nearly complete inactivity, and consciousness itself is found to be more or less absolutely inert.

All the cases of half-awakening which I have had occasion to observe were as a rule developed only when a person was awakened after a few hours of sleep. It was only in five cases that I was able to see this state of half-awakening in the morning after a good sleep of eight or ten hours. This makes our supposition about the rôle of the tonicity of blood-vessels in the appearance or non-appearance of half-awakening only the more probable. Everybody will agree that a sleep of from six to eight hours is sufficient even for a vascular system of marked inertia, because it gives the blood-vessels time to gather up such a quantity of energy that in the morning they can dilate with sufficient rapidity, and consequently the peculiar state of half-awakening is not found. In cases where this state of half-awakening is observed even after a sufficiently long sleep, it is always a sure sign of a pathological change taking place in the vascular system. And indeed in medical literature there exist descriptions of many cases in which the state of half-awakening was found to be exceptionally long, and in all these cases formed the first precursory phenomena of a coming mental disease. Such cases have been described by Schnittmüller and Brierre de Boismont, as I have already mentioned.

We cannot be surprised that the state of half-awakening is dependent on the condition of the vascular system, because we know that the late Professor Meynert has already demonstrated the predominating significance of the vascular system in the development of different mental diseases. From another side, Dr. Anjel has experimentally proved that the blood-vessels of persons suffering from neurasthenia lose their capacity to react by

dilatation or by contraction in answer to certain irritations; and, at the same time, it has been observed that the blood-vessels of neurasthenic persons do not show the well-known play of successive dilatations and contractions, by which the equilibrium between the opposite states of the vascular system is maintained. The importance of the vascular system for the mode of life of our organism is so great, that in his clinical lectures Professor Peter used to say the age of man is determined not so much by the number of years he has lived, as by the condition of his blood-vessels. If we reflect on his proposition: "On a l'âge de ses vaisseaux," we shall necessarily arrive at the conclusion that our health must also directly depend on the condition of our vessels, because if once we admit that our age is thus dependent on the state of our blood-vessels, so must be also our health; and so we arrive at the conclusion which Meynert tried to demonstrate.

After all that has been said here, it is easy to conceive that the state of half-awakening can be considered as normal only in those cases in which it appears after too short a sleep, and one which has been interrupted by force; or, in other words, this state of half-awakening can be considered as normal only in those cases in which the sleeping person has not had the necessary time for rest and for the restitution of the losses which his body has sustained before going to sleep.

When I was making my observations on this state of half-awakening, I remembered that in my youth I had heard something about the liability of such subjects to fright and to other emotions of the depressive type, and that I had been told of a youth of fifteen

who, on awaking, showed all signs of going to sleep again, when his sisters, annoyed by his sleepiness, pretended to cry, and told him that their elder sister (who acted as a mother to the family) had died suddenly, and that they awoke him because of that. Without a word the youth began to sob so desperately that he in his turn frightened his sisters, who, in order to soothe him, in vain told him it was a joke. They called in their elder sister, but their brother was beyond consolation, and although his sister was before him, could not understand that she was alive. Finally he fell into a fit of convulsions. The doctor was called in, and he at last succeeded in quieting the youth, who, nevertheless, suffered for some days.

The remembrance of this case gave me the idea to try if it is indeed so easy to make suggestions to persons in the state of half-awakening, and, at the same time, it showed me the necessity of prudence in experiments of this kind. The observations and experiences that I have made in this respect have proved to me that all ideas and emotions of a depressive character can be suggested much more easily than ideas or emotions of an exciting type; because, for example, the suggestion of anger or of joy occasioned mostly the complete arousing of the subject experimented upon in the state of half-awakening. This influence of anger and of joy is easy to understand, for emotions of such a type are always accompanied by a flow of blood towards the brain, and as sleep itself is possible only when the brain is containing less blood than in ordinary conditions, it is only natural that a comparative hyperæmia of the brain wakes up the sleeper, and also that it interrupts the peculiar state of half-awakening. It must not be forgotten that the famous

physiologist, Burdach, had already made the observation on himself that joyful dreams wake up the sleeper much more often than dreams of an opposite type.

The very fact that all exciting emotions have the power to interrupt the state of half-awakening serves as an indirect proof of the truth of the supposition that the half-awakening depends on the want of tonicity in the blood-vessels of the brain, in consequence of which they do not dilate quickly enough to awake the sleeper completely.

After having convinced myself of the possibility of employing the state of half-awakening for the suggestion of emotions, principally of the depressive type, I was naturally led to experiment if it was possible to make intellectual suggestions to persons who remain for some time in this peculiar state of half-awakening. The experiences consisted in suggesting to the half-awake person some illogical and absurd answer to a given question. In all such cases I observed one of two things, that is, the person experimented upon is either suggested and begins to repeat automatically the false answer, or the state of half-awakening is interrupted, and the person, now quite awake, gives a reasonable answer.

In my study of this peculiar state of half-awakening I had in view not only the relations of this state to sleep and dreams, but also the extent and the variations of suggestibility in different persons. I have already mentioned that I made one hundred observations on half-awakening in grown-up people. The age of these persons varied between fifteen and seventy years. Besides these observations, I have also made some experiments on children from three to fourteen years of age. These children

partly belonged to the educated classes and partly to the lower classes of society.

There are many persons who present this state when they are awakened in the middle of a profound sleep, but only for a very short time. When such subjects are thus waked up they do not at once regain their usual consciousness; they appear to be confused and not know where they really are and what is wanted of them; but this state lasts only for a few moments. Experience soon showed me that one cannot use cases of half-awakening for experiments of any kind, save perhaps for suggestions of fear, when they present a duration of less than fifteen seconds. And even the suggestions of fear are very far from being always successful in those cases, because persons in whom the state of half-awakening is very short-lived are not easily brought under suggestions even of emotional kind, so that when you shout at them, "We are burning," or "House on fire," instead of getting frightened at once in a reflex manner, they wake up instantly and completely, and with the air of a conscious observer ask, "Where is the fire?" and "What is burning?" Even in cases when one is successful enough to suggest the emotion of fear to these persons with a short-lived state of half-awakening, it lasts too short a time. This made me decide to count as cases of half-awakening only those in which this state has a duration of more than fifteen seconds. My observations showed me that this state of half-awakening can last from fifteen seconds to six minutes; in some cases the half-awakening lasted even more than six minutes, but cases of this kind are to be considered as wholly abnormal, and

they must inspire us with anxious doubts as to the mental health of persons presenting such unusually long periods of half-awakening.

As I have already said, my suggestions to persons in the half-awakened state consisted first of all of different emotions; principally I used to suggest emotions of fear and of anxiety, and sometimes also of sorrow; then in the second place I tried to suggest to them false judgments and opinions. The intellectual suggestions were always made in such a fashion that my questions contained the false answer which I wished to suggest. So, for example, I asked: "Tell me, does not three times two make five?" or "Do not you know that it has been snowing this summer?" or "What must we do to light a dark room? blow out the lamps?"

In cases where the state of half-awakening is very deep, each question that one asks the half-awake person calls forth the phenomenon of "echo"—that is to say, the subjects who are plunged in the half-awakened state begin to repeat mechanically the two last, or even only the last word of the question. It is almost needless to mention that in such cases of profound half-awakening there can be no question of suggestion.

In my observations I counted the intellectual suggestion as successful only in those cases when the persons plunged in the half-awakened state gave me suggested false answers with a certain conviction and a certain insistance, saying, for example, "Certainly three times two make five," etc. A mechanical and automatical repetition of words used in my question was considered by me as a direct proof of the incapacity of the person experimented upon to take in

intellectual suggestions; in such cases I tried next to suggest an emotion of some kind or other, and in this I was mostly successful.

The duration of half-awakening was much more considerable in children, and especially in children belonging to the working classes; in them the half-awakening lasted often from five to six minutes. Of the persons whom I observed in this state nearly a third were Finlanders (of 84 persons 27 were from Finland), and as all of them presented a very marked and a very long state of half-awakening, I cannot look on this as a pure accident, but I think that we have here a national peculiarity. Perhaps this liability to the state of half-awakening is explained by the fact that amongst the natives of Finland it is nearly impossible to find a person of sanguine temperament.

As has been mentioned above, the state of half-awakening is met far more often amongst people living by the work of their muscles, and, to judge by my observations, intellectual pursuits must be very unfavourable to the development of half-awakening. But the difference does not end here: to my surprise I have remarked that men and women belonging to the same class of society, and consequently possessing more or less the same intellectual development, present nevertheless a marked difference in their liability to the half-awakening state. And what astonished me still more was that this difference was wholly to the advantage of women, as it appeared that they have much less liability to fall into this state of half-awakening than the men of a corresponding *position* in life. So, for example, in experimenting

on 30 women I met with 60 cases of half-awakening, and at the same time 13 men have presented this half-awakening 40 times. This difference cannot be explained by a predominance of intellectuality; I think that we must search for an explanation in those qualities of women which make it so easy for them to hear every cry and even every slight movement of their children, and that notwithstanding that they are fast asleep. The same qualities make women excellent sick-nurses. This difference between the sexes does not depend upon different occupations, but most probably it takes its source in variations of the organisation, because it shows itself even in children, and that from the first years of life, when no kind of occupation could have had any influence.

It is necessary to remark here that for my experiments and observations I took only those subjects who presented more or less easily the state of half-awakening, and on every such subject I made ten separate experiments—that is to say, each subject has been ten times waked up from the most profound sleep. To be sure that the sleep in every case was interrupted at its most profound degree, I strictly observed the rule that the sleeper should be awakened only after two and a half or three hours of quiet sleep. It is to be understood that each observation was repeated only after an interval of some days. Persons who presented only a very short-lived half-awakening, as well as those who did not present it at all, were excluded from these experiments; but before deciding this question it was necessary to make two or three experiments with every person. As far as I can judge by my observations, made at long intervals in the course of several years, children present this state of

half-awakening very often in comparison with grown-up people. Among grown-up people I have found the half-awakening state in one out of every ten observed subjects; but if taken in separate groups, the working men and women, and the subjects with intellectual or commercial or artistic pursuits, gave a marked difference, so that in the working men and women group one person presented the half-awakening out of every four observed persons. In the group consisting of merchants, artists, military men, and so on, there were 2 such subjects to every 25 persons, and in the intellectual group only 1 to every 50 persons. Among children the liability to fall into a half-awakened state was more marked the younger they were, so that in those whose age was between three and six or seven years of age, the half-awakening was met in 8 out of every 10 subjects, and in children between seven and fifteen years of age this proportion sank to 4 out of every 10 subjects. I am certain that if one could make these observations on a larger scale, taking note of every detail of age, development, occupation, sex, nationality, and hereditary predisposition to diseases, etc., one would get results that would throw much light on many questions of physiology and psychology. But for such observations the co-operative work of many persons would be needed. This work of mine was carried on from 1890 to 1895.

When the persons liable to half-awakening have been found, it is necessary to take account not only of the successful experiments, but also of the unsuccessful ones, because there are, individually, considerable differences in degree, frequency, depth of *state, etc.* The differences that are seen in this

direction present also a certain relation to age, to sex, to intellectual development, and so on. So, for example, I had under observation eight children, from three to six years of age, belonging to the lower social classes. Four of them were girls, and out of 40 experiments they presented the half-awakening 25 times, while the four boys presented it 35 times. Of children belonging to the educated class, and between the age of three to six years, I had under observation only five subjects; three of them were girls, and out of 30 experiments they presented the half-awakening 15 times, while the two boys presented it 17 times out of 20.

With my latest experiments, I have had in all under observation 16 children between the age of seven and fifteen years—6 boys and 10 girls. The boys have presented the half-awakening 29 times out of 60 experiments, while the 10 girls showed it 34 times out of 100 experiments. Among the 6 boys there were 4 belonging to the lower classes, and out of 40 experiments they showed the half-awakening 25 times; among the 10 girls there were 7 belonging to the working classes, and they presented the half-awakening 28 times out of 70 experiments, while the remaining three girls of the educated classes presented the half-awakening 6 times out of 30 experiments.

The age of 25 to 40 years seems to be the most unfavourable for the development of half-awakening; after 40 years, and particularly after 50 years, the state of half-awakening begins again to show itself more often, and I think that the chief cause of this fact is to be looked for in those pathological changes that are so often observed at this time of life

in the walls of the blood-vessels. I cannot give here the exact numbers of persons showing a liability to half-awakening at different ages. But, at all events, I have noted the fact that the age between 25 to 40 years of life has given me the smallest number of cases of half-awakening; and we arrive at the same conclusion when we make a comparison between the numbers of repetition of the state of half-awakening in persons of different age. So, for example, 17 persons were between 15 to 24 years; they showed the half-awakening 41 times (each of them was subjected to the experience, as always in these observations, 10 times); 24 persons of the age between 25 to 40 years of life presented the half-awakening in 23 cases (out of 240 experiments), while 14 subjects between 41 to 70 years of age have shown the half-awakening 36 times.

In judging the predominance of half-awakening in the group of persons from 15 to 24 years of age we must not forget that there were young girls in this group, and my observations have shown me that women of this age present mostly a more marked predisposition to the half-awakening than men of the same age or than women of more advanced age. For a just appreciation of this result it must be remarked that among the women of this group (15 to 24) there were some girls still below puberty and who presented at the same time marked signs of anæmia. After what I have observed I am convinced that anæmia forms a weighty predisposing cause in the development of the half-awakening state.

Intellectual suggestions, that is suggestions of different false ideas, various false and absurd representations, have shown in the most decided manner

that children have a most marked predisposition for suggestions of this kind, and that this predisposition shows itself the more strongly the younger the children are. So it was that among 55 persons of over 15 years of age the intellectual suggestions were successful only in 25 per cent. of all the cases in which such suggestions were tried, while emotive suggestions were successful in 45 per cent. On the contrary, children under 15 years of age showed successful intellectual suggestions in 85 per cent., while emotive suggestions were with them nearly always successful; at least, in my experiments they were successful in 97 per cent.

A special interest attaches to cases in which the persons undergoing suggestions during the half-awakening state do not wake up completely, but after remaining some time in the half-conscious state are again plunged in a profound sleep as soon as the experiment is finished. In these cases it happened sometimes that persons experimented upon told us, after getting up in the morning, of all we had been suggesting to them in their state of half-awakening; but they told of it as of a dream that they had had in the night. In other words, in cases when the half-awakening passed directly into a profound sleep, the persons experimented upon never remembered the fact that they had been waked up during the night, and their memory retained the contents of the suggestion only in the form of a dream that they supposed they had dreamed during the night. Cases of this kind I have met with only rarely, and the apparent reason of it must be looked for in the fact that the half-awakening is only in very few cases deep enough to pass with-

out interruption—that is without a complete waking up —into a profound sleep directly after the experiment is finished. Besides this, the remembrance of the received suggestion was not always retained by the memory of the person passing uninterruptedly from half-awakening into a sleep consecutive to the experiment; very often such persons on waking up in the morning did not remember anything, and were strongly convinced that they had slept the whole night in a profound sleep without any trace of a dream whatever.

Altogether I have met with 35 cases in which the half-awakening passed directly into a sound sleep; but in 10 of these cases the subjects did not remember anything on getting up in the morning. In the remaining 25 cases a simple remembrance of the suggested idea or emotion has been observed in 17 cases (68 per cent.), and in all these 17 cases the persons experimented upon were strongly convinced that they had been dreaming about snowing during a hot summer's day, or about a house being on fire; and so on.

In all such cases the recollection that remained of the suggestion contained always an emotive element; so, for example, these persons remembered mostly the emotions of fright, of anxiety, of sorrow, that were suggested to them, and even when they remembered an intellectual suggestion they remembered it always on the emotive side—that is, they remembered it only because it had evoked in their half-conscious soul the emotion of wonder; as it was, for example, with the suggested idea of snow during a summer's day.

In some cases the subjects on getting up in the

morning began not only to speak about the suggested idea, but they surrounded this idea with details which were quite foreign to the suggestion made by me; so, for example, they spoke about the landscape in which they saw the snow falling on a warm summer's day, and they added some other details that were not included by me in the suggestion. Cases of this kind can be explained only by the supposition that the suggested idea has served as a theme on which the dreams had been spinning their fantastic creations, so that around a simple suggested idea there has been formed different pictures more or less complicated.

Considering that suggestions made during the half-awakening can leave on the cerebral system such a strong trace that the subjects remember them even after a sound sleep of many hours, or that they employ them as canvas for their different dreams, which in their turn reinforce still further the traces left by suggestion, considering all this, we come to the conclusion that thoughts, wishes, and sentiments suggested amidst certain conditions can in fact sometimes leave traces so strong that they do not disappear wholly, but even influence the real life of the subject in a more or less marked way. The truth of this supposition is supported by many occurrences in everyday life, as when we are during many hours sorrowful or glad solely in consequence of some silly dream that we had in the night. I remember having read about a worthy old German professor who had dreamt one night of being again a child and of being subjected to a thorough thrashing. Getting up in the morning the old professor felt himself quite out of sorts, and the whole

day he vainly tried to restore his ordinary good humour; the remembrance of the thrashing of which he had been dreaming had robbed him of his ordinary peaceful and joyful disposition, although he enjoyed perfect health. In the following chapter we shall have to return to the consideration of this subject.

In such cases as these we have an example of an involuntary and accidental self-suggestion of different emotive states, and it would be very interesting to find out and to define exactly the conditions which make us so impressionable to suggestions that can even be made by our dreams. As far as I could remark, in the course of my observations, suggestions of this kind, that is, suggestions produced by dreams and showing their influence in the real life of men, are to be seen only when there are present unmistakable signs of cerebral overwork, which unhappily is very often met with nowadays.

In persons who presented a long and profound half-awakening I remarked nearly always a marked predisposition to a cataleptic condition of different muscular groups; it was comparatively easy to bring the extremities of such a person into any position without waking up the subject experimented upon, and then the limbs remained in these often very tiresome positions for a more or less long time, and it happened sometimes that they remained in such positions the whole time of the half-awakening. Even in cases when no attempt was made to place the extremities in other positions, they showed of themselves a cataleptic condition, and were sometimes fixed by it in the most unnatural positions. In cases where the *half-awakening* was very deep it happened sometimes

that the person under observation was standing or walking in the room, but all this with the air of an unconscious automaton. The best means to arouse a person from the half-awakening I found to be simple blowing in his face, or throwing on to it some drops of cold water. These simple means acted more energetically than calling or even shaking the person, and the like rough manipulations. The same result of blowing into the face or of throwing drops of cold water is observed, as every one knows, in cases of hypnotic sleep, and after all I have seen in relation to the half-awakening I am led to consider it as a natural hypnotic state, while the so-called hypnotic state presents, in my opinion, nothing more than a half-awakening produced by artificial means. I have already expounded this view in my lectures of 1894, and now, after a series of experiments, I am still more convinced of the complete analogy of the hypnagogic and the hypnotic state.

The fact that the half-awakening can be in the easiest and the most effective way interrupted by simply blowing into the face, while rougher manipulations remain without effect, is in a high degree interesting, because it proves the correctness of our supposition about the vasomotor foundation of the half-awakening. In 1882 I proved by a series of experiments, which were afterwards confirmed by Dr. Istomanoff and other experimenters, that the smallest irritations of the skin of the face by tickling, such as the lightest touch of a feather or blowing, are sufficient to occasion the most marked effects in the vasomotor system, calling forth a dilatation of the brain vessels and a corresponding contraction of the skin vessels of the arm and ex-

tremities in general. And now we see that blowing into the face is most effective in interrupting the half-awakening, which, as we may suppose, depends on an insufficient dilatation of the brain vessels of the untimely awakened sleeper. The tickling of the face by a feather I have also tried in some few cases, and it proved as effective as blowing into the face.

Further analogy between the half-awakening and the hypnotic state is seen in the fact that by frequent repetition the liability to half-awakening is strengthened, and a kind of habit is as easily formed as for the hypnotic sleep. This makes strict carefulness and prudence the more necessary in every kind of experiment with the half-awakening.

The pulse during the half-awakening showed always an evident tendency to become lower; so, for example, three persons of the age of 16, 18, and 21 years, presenting ordinarily a pulse of 90, 85, and 92 beats in the minute, showed during the half-awakening only 60, 70, and 56 strokes; and subjects of 35 and 55 years, having ordinarily a pulse of 70 and 60 beats, presented during half-awakening 54 and 49 beats of the pulse. But it must be remarked that this pulse rate was not constant; on the contrary, it changed more or less, and these changes were especially marked during successful emotional suggestions. So every time when the emotion of fright was suggested I have remarked first a slowing of the pulse, that sometimes amounted to a momentary pause, and then there developed a more or less distinct acceleration. In all cases in which this acceleration was very marked (20 and more beats) it was followed by an immediate awakening of the observed person.

The respiration, as far as I could remark, was in half-awakening very irregular, showing accelerations and pauses; but if the subjects were left alone their respiration very soon subsided. Before leaving the physical side of this state I must mention that the face of half-awakened persons had always a somewhat tumefied look, which was most strongly marked in the region of the eyelids.

My observations on suggestion during the hypnagogic state have shown me, in the most unmistakable manner, that, *cæteris paribus*, emotions are far more easily suggested than any ideas or judgments and conclusions. This cannot astonish us, because the same observations have shown that the state appears the more easily as the intellectual development of the observed person is comparatively low, and lasts the longer as the person observed has the more feeble capacity for judgment. It follows, consequently, that a strong intelligence, a powerful capacity for judgment in a person, make him inaccessible to suggestions, and at the time also make him incapable of the half-awakening. Once we know all this, we can understand that intellectual suggestions cannot be so easily made as the emotive ones, because every intellectual suggestion must necessarily call forth the function of judgment, and once it is called forth it must necessarily interrupt the half-awakening and make every suggestion impossible.

Turning from the psychical side to the physical side, the most important condition for the development of half-awakening and of suggestibility we have found to be different anomalies of the vascular system, and especially a want of tonus in the walls of the blood-vessels, and their consequent inertness.

As has been mentioned before, children are most predisposed to the half-awakening and to suggestions, and it may well be asked how this fact is to be explained, as the vascular system of children could not be considered to be naturally subjected to pathological changes of different kinds. Certainly, if any have the right to possess healthy blood-vessels, they must be our children. All this is quite true; but then it must not be forgotten that, as the judgment and all the intellectual forces of children are in an undeveloped condition, so are also their blood-vessels.

In this respect Professor Beneke has made highly interesting observations and measurements, which have, for example, proved that the volume of the heart enlarges during the years of infancy, of childhood, and of first youth, to twelve times its first size, because in the newly-born baby it is equal to about 20-25 cub. cent., and in an adult man the volume of the heart is already equal to 260-310 cub. cent. The circumference of the ascending aorta gets three and a half times larger as the child grows up to be an adult man or woman, and the same process of enlargement is going on also with the circumferences of the thoracic aorta, of the abdominal aorta, with the circumferences of the iliac artery, of the subclavian artery, of the carotid, etc. It has been shown also that the respective relations of the different blood-vessels to one another are also changing as the child grows up; so, for example, the pulmonary is broader by nearly five millimetres than the ascending aorta in the child, while in a grown-up person both these vessels are equal, or the pulmonary becomes *even* somewhat narrower than the aorta. It is also

to be remembered that in proportion as the body is growing, the different blood-vessels, together with the lymphatic ducts, are also getting longer, and all this must necessarily change more or less, not only the respective relations of the blood-vessels one to the other, but also the condition of their walls.

After all that has been said, it is easy to understand why children present very pronounced half-awakenings and a considerable liability to suggestion, and that, notwithstanding, a healthy condition of the heart and blood-vessels. In children the heart and the blood-vessels are, so to say, in an unfinished state, and not capable of passing from one condition into another as quickly and as thoroughly as in healthy grown-up people, and consequently the cerebral blood-vessels, when narrowed under the influence of the contraction occasioned by sleep, cannot dilate at once when the child is awakened in the middle of a sound sleep; in remaining for some time contracted the cerebral blood-vessels realise the anatomico-physiological conditions for the development of half-awakening. On the psychical side, moreover, we find in children a more or less marked weakness of judgment, of consciousness and intellect in general, and so children are very prone to every kind of suggestion, not only during the half-awakening state, but also in their everyday life. The suggestibility of children is shown very often in their play, and is wrongly taken for a sign of a lively imagination.

Before leaving the question of half-awakening I must mention that in ten subjects, from seven to seventeen years of age, I have tried to weaken the

predisposition to half-awakening, and to produce, if possible, progressively, a complete destruction of this predisposition. With this end in view I awakened the subjects chosen for these experiments at different hours of the night and of the morning, and noting the signs of half-awakening, I continued to use every means of waking them till I aroused them completely. The disposition to half-awakening became weaker and weaker, and at last, in some cases, it disappeared completely, but only in some cases; in others it persisted though in a less degree.

These experiments illustrate very well the importance of exercise even in this direction, and when a marked disposition to half-awakening is observed it would be well to counteract this disposition by systematic unexpected awakening at different hours of the night and morning. As I have said, women show less disposition to half-awakening than men, and it is more than probable that their comparative freedom has been attained thanks to their children, as they have thus been obliged to exercise themselves in waking up at different hours of the night and morning. It would be certainly interesting to make observations on soldiers and sailors, who are so often obliged to be on duty in the hours of the night, and to compare the percentage of half-awakening in them with the percentage of such cases in simple labourers, peasants, farmers, etc. I think that there would be found a considerable difference. Personally I had no opportunity of making these comparative observations, but I tried to replace them by experiments on midwives, and I certainly obtained the conviction that among midwives it is more difficult to find cases of half-awakening than among dress-

makers, servants, or even governesses and women with intellectual pursuits.

In the course of these experiments I remarked further that a cool bedroom lessens the predisposition to half-awakening, while too warm a temperature in the bedroom increases it and at the same time makes the half-awakening itself more profound. In general too warm a bedroom (68° to 73° F.) has a bad influence not only on persons disposed to half-awakening, but in general on all those whose tissues have an enfeebled tonicity and whose respiratory exchange is not active enough. I have made some experiments by putting a bag filled with cold water to the head of those sleeping persons whose disposition to half-awakening was already known to me, and in those cases I have always observed that the half-awakening was either considerably shortened and weakened or altogether dispersed.

Before concluding I may mention here the following observation accidentally made: two girls, of the ages of seven and eight and a half years, sisters, and both remarkably predisposed to the half-awakening, lived with their mother, a washerwoman in a gentleman's house. As they were left to their own devices all day, the lady of the house found it necessary to place them in a school as day-scholars; school-life agreed well with both the girls, and in a short time they were among the best of their class. Under the influence of school-life and occupation the disposition to half-awakening was more and more weakened, and a year after their entrance into the school disappeared altogether and did not reappear until the years of puberty, when both of them began again to show a very decided predisposition to the

half-awakening. At the same time both the sisters began to show marked signs of chlorosis.

After all that has been said about the hypnagogic state and the means to combat it, every one, I think, will agree with me that it is desirable from time to time to change the hours of getting up, as well as the hours of going to sleep, because by this one gets accustomed quickly and at any hour of sleep to regain his full consciousness. Going to sleep at a certain hour very soon becomes a habit, and sleepiness comes on at the accustomed time; the same is to be remarked in reference to getting up. My observations of children showed me that those of them who through childhood are made to observe strictly regular hours in going to sleep and in getting up are more prone to fall into the half-awakening state on being aroused at an unusual hour than others not accustomed to such absolute regularity. In my dealings with children I have found it very useful to change the hour of their going to sleep and getting up at different seasons of the year, so that in spring and in summer they were made to get up much earlier than in autumn and in winter. From time to time in summer it is good to arrange some pleasure party in the early hours of the morning, so that every one has to get up at 4.30 or 5 o'clock in the morning. And the same variations must be made from time to time in the hours of going to sleep, so that children obtain permission to sit up. To sit up from time to time, if not made a rule, is very useful, because we thus break up too great a uniformity in our habits and accustom ourselves to go to sleep at different hours, and this makes us

less liable to sleeplessness. By getting accustomed to go to sleep always at the same hour we soon find ourselves incapable of sleep once the accustomed hour is changed.

Of all the gifts given to mankind consciousness is the most precious, and we must seek to strengthen and to make it as much as possible voluntary, that is, ready to answer to any call. To attain this it is necessary to weaken as much as possible every liability to half-awakening, every liability to suggestions of every kind, and, consequently, it is necessary to strengthen as much as possible the intellectual forces, the capacity for judgment, because they form, as direct experiments have shown us, the best preservative against half-awakenings, suggestibility, and the like.

As a general rule, the more easily consciousness is effaced under the influences of various causes, the more predisposed is the subject to nervous and mental diseases, including convulsive affections. So true is this that medical science shows that men of strong and decided character resist better than others the influence of alcohol, chloroform, and other anæsthetics and narcotics, and also, as we have seen, the half-waking state, in a word, all the influences which interrupt the activity of consciousness. And if we think of the meaning usually attributed to the word, a strong character simply means a strong and uniform consciousness. On the other hand, whatever weakens consciousness also predisposes to nervous and mental diseases; thus the frequent use of narcotics or alcohol, attacks of epilepsy or narcolepsy, all conduce to mental weakness and to mental disease. Even an excess of normal sleep is injurious, and, still more,

frequently repeated hypnosis. Thus it is easy to understand that a pronounced hypnagogic state may cause some anxiety, since it indicates a tendency for consciousness to remain plunged in the inactivity of sleep.

No doubt in our day there are whole groups of persons who pass their lives in what may be called a continuous hypnagogic state,—I do not mean among savage populations, but in our own civilised European world,—and who remain all their lives long in so low a stage of development that, as the Russian poet says, they only see their fellow-men in a dream. How can we develop and strengthen the feeble pathological consciousness of such persons? Before all things, certainly, by a genuine love of man, of one's neighbour, of the whole of humanity. That such a love of one's fellow-man may work miracles even on primitive savages and cannibals is shown by the life of the indefatigable explorer, Miklucho-Macleay. Alone, without any armed force, he ventured among cannibals who had never seen an European. Not only did he return safe and sound, but he gained the hearts of these savage hordes, not by brute force, but by his own humanity and love of humanity even in the forms of these poor creatures, who had yet had no chance of taking their share in true human life.

All that such life means we are as yet unable to tell. At present we cannot represent to ourselves what the future life of man on earth will be when consciousness shall have reached greater development. Bunge, in his treatise on physiological chemistry, even goes so far as to declare that the time will come when man will have so far developed that between us *and this* future humanity there will be the same

immeasurable distance that there now is between the infusoria and contemporary man.

From all that goes before it is clear that there is an intimate connection between sleep and consciousness, and that the depth and amount of sleep are in inverse proportion to energy of consciousness, so that the study of both must follow a parallel course. It is not, therefore, surprising that our knowledge of sleep, like that of consciousness, is but fragmentary, and that, therefore, in this sketch of the hygiene of sleep I have been forced to search in various and scattered directions for the facts and observations which I have here tried to work into a more or less homogeneous and complete whole. On many points medical literature furnishes as yet no information, even in the form of isolated facts. It was therefore necessary, in part to undertake new experimental studies, in part to acknowledge that in the present state of science it is impossible to furnish precise answers to a whole series of questions concerning essential points in the knowledge of life during sleep. The reader must, therefore, be indulgent towards lacunæ which can only be filled up by the united labour of many experimenters.

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CHAPTER IV.

THE PSYCHOLOGY OF SLEEP.

In Sleep each enters his own Psychic World—The Independent Life of the Nervous and Cerebral Centres—Subjective Visual Images—Hypnagogic phenomena—Subjective Auditory Images—Presentation Dreams and Representation Dreams—Part played by the various Sense Organs in Dreams—Sight, Hearing, Touch, Taste, Smell, etc.—Visceral Organs and Cœnæsthesia in Dreaming—The Muscular Sense in Dreams—Failure of Movement in Dreams—The Emotions in Dreams—Dreaming is associated with Intellectual Development—The Speech Element in Dreams—Positive and Negative Images left by Dream Forms—Causality in Dreaming—Dreaming in relation to Insanity—The Analogy of Alcoholic Insanity to Dreaming—Morbid Dreams—Prodromic Dreams—Dreams as Symptoms of Disease—Nightmare—The Dreams of the Blind—The Dreams of Persons with Amputated Limbs—The Dreams of Criminals—The Utility of Dreams—The Significance of Dreaming.

As we have already seen, the sleep of the brain is only partial. Thus during sleep there is a certain amount of psychic life, and this concluding chapter will be devoted to the analysis and study of the psychic life of sleep.

Heracleitus,[1] and in modern times Kant and Maudsley, have observed that while during waking

[1] "To those who are awake there is one world in common, but of those who are asleep each is withdrawn into a private world of his own" (as quoted by Plutarch, *De Superstit.*, 3).

life each of us lives with a general life bound up with the common existence of other human beings with whom he is grouped, during sleep each of us is buried in his own world. This remark—thus made by thinkers who were in the first place metaphysicians—expresses the fundamental difference between the study of man by anatomists, physiologists, and histologists, and the study of man from the psychological and subjective side. Physiologists and psycho-physiologists have determined the rapidity of the different sensations along the nervous tracks; they have measured the time required for an act of perception or of will. They have begun to calculate the rapidity and number of associations of ideas and images (Galton, Trautschold, etc.). But the more these important facts are gathered and collected the stronger becomes the conviction in the minds of serious investigators that by these methods we have only reached the exterior side of man, and that such facts do not serve to explain the intimate nature of man, his essence, the kernel of his being. Thus we know that the blood as it circulates through the body is subject to hydrostatic and hydrodynamic laws, and we know perfectly the structure and innervation of cardiac muscle; but we cannot explain the primary and fundamental cause of cardiac contraction, or that of the vessel walls. We may say the same of the processes of digestion and absorption. We know that the old theories which reduced nutrition to phenomena of endosmosis, diffusion, and exosmosis are false, since in these processes an active part is played by the different cellular elements, which exert choice among the substances brought to them along the *digestive* tracts, and probably also among those brought

in the blood; but why they exert this choice, why, for example, they absorb a drop of fat and refuse a granule of pigment, remains quite unknown. And even if we pretend to explain this elective affinity by showing that what seems to be choice is really the action of law, let us say of chemical affinity, we have not discovered the reason of the phenomenon, but only put the difficulty a step further back; for in attempting to explain the facts by chemical affinity we still have to explain chemical affinity itself.

As regards the action of the nervous and cerebral system, this inability of physical science to give a definite explanation is still more marked. We may determine the rapidity with which a stimulus travels along a nerve; we may determine the time necessary for the production of a conscious sensation or of an act of will; we may even measure the volume of consciousness (Dietze); but we are not thereby helped to understand the fundamental reason of psychic life, nor to understand how a nervous stimulus and the activity of certain nervous cells is transformed into a conscious and living thought. To such an extent is this the case that from a strictly biological point of view it is often found convenient to ignore altogether the psychic phenomena of consciousness as an unimportant epiphenomenon, absolutely useless for the study of the phenomena of life.[1]

On these grounds it is now widely recognised among men of science that in explaining the psychic world of man we cannot dispense with internal observation, and subjective methods of investigation (Volkelt, Wundt, etc.); and even from the physical

[1] See, *e.g.*, F. Le Dantec, *Le Determinisme Biologique et la Personnalité Consciente*, 1897.

side, Bunge, the distinguished Basle professor, insists in his well-known treatise on physiological chemistry on the need of studying the individual consciousness. Thus psychology regains the rights that at one time it seemed to be losing.

In the study of sleep the subjective method is of the first importance. In fact, all the complicated conditions of social existence which during waking life we are all obliged to conform to or to resist are eliminated during sleep, and the psychic life of dreams unrolls freely without the impeding fetters of social laws. It cannot be denied that these social laws, which surround every human existence, sometimes become a heavy burden, and that they develop at the same time a certain hypocrisy in feeling and thought and action, and thus give rise to endless falsehood and deceit. In sleep all this changes. We are delivered from the heavy burden imposed by those vital conditions which by virtue of historical development have gained a certain empire in a given nation or society, but which are very often at the same time not merely opposed to the desires and impulses of men, but even injurious to the development and well-being of individuals who live in the midst of the nation or society. From all these conventional chains we are liberated during sleep and brought, as it were, face to face with Nature. During sleep—as the philosophic physiologist Burdach remarked—all social differences disappear; and men attain that perfect equality which in the waking state they can only dream of. Thus an analysis of the psychic phenomena of sleep seems to me adapted to throw much interesting light on the subjective side of man.

The Independent Life of the Nerves—Vision, etc.— To understand the intimate nature of psychic life during sleep we must first take into account what the psycho-physiological language of the beginning of the century called "the life peculiar to the nerves," "the special life of the organs of sense," "the chaos of apparitions belonging to the sleepy state," etc. (Johannes Müller, Purkinje, Grüithuisen, Herschel), and also of subjective visual phenomena. We must ask ourselves in what this individual or "essential" life of the different nervous and cerebral apparatus is, and whether it possesses any serious significance.

In the first place, I may point out that it is recognised that every nervous stimulus, every sensation or idea, leaves a trace in the cerebro-nervous system, and thus all the obscure motions generated in the organism may afterwards revive temporarily under the impulsion of consciousness, or spontaneously by the action of unknown causes, by the influence of an unusual afflux of blood or other reason. At the bottom of this faculty lies that "memory" which is peculiar not only to each organ, but to each tissue, to each cell of the body (Henle). It is by this "memory" that some explain the preservation of species through infinite series of generations and the hereditary transmission of physical and mental characters. It was in this way, as the after-images of sensation, that even Aristotle seems to have accounted for dreams.

An English writer, Francis Cane, has summarised the chief of the auto-sensations generated physiologically within the body, and sometimes increased or modified by pathological conditions; and though even the summary of these very numerous phenomena is

somewhat long, it may be well to quote it here in its bearing on the psychic life of sleep. "We must remember that the human body is a complicated machine made up of numerous secondary machines in themselves composed of a most intricate molecular machinery. This organism is unified and controlled by the sensory and motor nerve filaments which communicate in leashes with the great central nervous 'exchange' of the brain. It is ever changing from minute to minute in its molecular constitution, and these changes result in countless chemical reactions and physical transformations of energy. It is most delicately responsive to all its surroundings, and is presided over by an intelligism which has impressed on itself what I may call a sensographic record of all that it has learned from the moment when the deep sleep of its embryonic existence was first broken by its birth into the external world of matter and of sense.

"Briefly considering what takes place in the human body while asleep, we find that there are actual and innumerable sounds, sights, and feelings which are partially conveyed to the intelligism, while that intelligism is deprived of its full means to test their nature. We have twitchings or spasms of muscular fibres, of muscles, and of groups of muscles. We have extensions and contractions of limbs, with the sensations of impediment likely to accrue from tight or overmuch bedclothing. We have painful conditions of muscles, nerves, and blood-vessels from awkward positions of the sleeper. We have the movements of the breathing apparatus; heart movements and sensations of beating arteries and distended veins; conditions of the sexual *apparatus* and states of different organs, such as

distended bladder, overloaded stomach, and feeling of flatus in the bowels. Sounds innumerable are developed by the heart and arteries and veins; by the mouth and nose, as in snoring, grinding of teeth, and working of saliva; and many mechanical noises in the ears themselves. There are, besides, a host of molecular sounds which must be present, although usually not perceived. In the eye we have those extra-retinal entoptic phenomena due to opaque particles in the transparent media, which, in our waking moments, frequently appear projected into space as drops, striæ, lines, twisted bodies, forms of grotesque shape, and black dancing spots, often mistaken by the ignorant or inexperienced for natural objects, such as flies, worms, or birds.[1] As an intra-retinal appearance I may mention the way in which we can see the branches of vessels in our own retinæ under the form of Purkinje's spectre. Moreover, there are the numerous pathological conditions, such as hyperæsthesia or dysæsthesia of one or more nerves, set of nerves, or branches. In the optic nerve these conditions cause photopsia or flashes of light, flames, sparks, and stars. In the auditory nerve we have humming, buzzing, singing, ringing of bells, violent explosions, and even words or conversations. In the olfactory nerve and nerves of taste we have odours and flavours. Many of these pathological phenomena are simply the hyperæsthetic nerves picking up the physiological

[1] For an interesting series of cases, illustrating Dr. Cane's remarks on this point, see a paper by Dr. W. Colman describing hallucinations occurring during ill health in some persons, and associated with disorders in the sensory organs and the presence of floating bodies in the eye, etc., *British Medical Journal*, 12th May 1894

sights, sounds, and sensations. The visual aspect of dreams, or how we see light, colour, and form, is thus, to my mind, made quite clear when we come to study the lights existing or developed in the organism. From the nature and composition of the body it is physically certain that they must be present. Phosphorus emits light; so do calcic sulphide, boric sulphide, chalk, silk, teeth, and other substances. The emission of light is one of the properties of protoplasm. Phosphorus enters largely into the composition of the human body, being present as phosphates in the bones and other tissues. It exists in muscle as a combination of phosphoric acid. It exists as a phosphuretted fat in the lecithin of blood-corpuscles and of nerve and brain tissue. As oxygen is being constantly conveyed to these phosphuretted tissues, light will certainly be generated. It would be interesting to know if a micro-photograph of the circulation could be taken after long exposure in darkness with a very sensitive plate. Pressure on the globe of the eye, even in the dark, will produce phosphenes, which appear as flashes of light or pale luminous centres, with circles of one or more colours. These are also produced by electrical currents. In a dark room with our eyes closed, we see that area of dim light called 'the proper field of the retina,' and across which many see dim moving figures and shades of colour, which blend and dissolve fantastically. This field gets gradually brighter the longer we abstain from viewing actual light. Therefore, from the chemical reactions involved, from biological analogy, and from physiological and pathological facts, we have good reason to believe that there is *actual light* produced within the body itself. We know

that heat in varying intensity is produced, and that electricity is also developed by muscular activity." [1]

We all know these phenomena more or less. We have sometimes heard melodies, or sometimes a voice calling us by name, in the absence of any exterior sound. All such phenomena are the results of the subjective

[1] Francis E. Cane, "The Physiology of Dreams," *Lancet*, 28th December 1889. Dr. Cane has some further interesting remarks concerning the spontaneous evolution of light phenomena in animals generally:—"We have numerous examples in nature of organisms developing light within themselves. Many plants, including some cryptogams, are luminous. A large portion of animal nature is phosphorescent, of which we have familiar examples in the glow-worms and fire-flies. Mr. Hoyle, of the *Challenger* expeditions, has written some interesting matter on this subject. The general phosphorescence of the sea is due to pyrocystis, peridinium, noctiluca miliaris, and other low microscopic forms in their countless millions. Certain animalcules found in the tropics give off phosphorescent particles so diffusive that a tumbler of water containing one will become completely illuminated. The bright spots we see at the sides and in the wakes of vessels are due to salpæ, medusæ, and copepods, or surface crustaceans. Other crustaceans, several families of annelids, some beetles, and many fishes are phosphorescent. The luminous round shining bodies found on certain fish contain in their interior little lenticular bodies like eyes, and are considered by some naturalists as true organs of vision, or accessory eyes. Some crustaceans have also these eye-like organs. The light given out by phosphorescent animals is usually pale bluish in colour, but red, green, and purple are noticed in some animals. A form of apendicularia has the power to change its light from red to green, and finally blue. The intensity of the light is not very great, that of the sea at its brightest being obliterated by very little moonlight. The nature of the light is always monochromatic. The causes of phosphorescence are probably various. Some animals get luminous from feeding on putrid phosphorescent matter. Dead and putrescent animals are frequently phosphorescent. This is well known in the examples of fish and molluscs. The human cadaver is occasionally phosphorescent, and Phipson, in his work on *Phosphorescence*, records instances where human beings have been phosphorescent while alive. This is the case in the rare condition of phosphoridrosis or luminous sweat, which is sometimes seen in the last stages of phthisis, in miliaria, and in persons who have eaten putrid fish."

activity of the auditory apparatus, while the same phenomena are observed in all the other sensory spheres.

It need scarcely be added that the number of these traces varies in various systems of fibres or cells, and that their power of creating different images and sensations, or even feelings and ideas, without the help of exterior nervous stimuli and irritations, is the more energetic the more abundant and rich these traces are. For this reason the subjective phenomena of vision, which have been especially studied, have a predominant importance from the present point of view and deserve our special attention.[1]

The best moment for observing the influence of the visual apparatus in producing dreams and hypnagogic hallucinations is the moment before going to sleep. Then we may often see passing before our eyes a whole series of visual images; in some people luminous phenomena predominate; in some, human forms; while other people most often see flowers or landscapes, or again, the capricious play of arabesques or geometrical figures. These subjective pheno-

[1] Hyslop (*Mental Physiology*, p. 267) enumerates the following phenomena within the eye as causes of subjective hallucinations:—(1) *Shadows* formed upon the retina by opaque bodies. These are (*a*) the *spectrum muco-lacrimale;* (*b*) wrinkled shadows, due to folds in the cornea; (*c*) lens shadows; (*d*) *muscæ volitantes.* (2) *Purkinje's* figure, due to a shadow of the blood-vessels within the retina cast upon the most external layer of the retina. (3) *Movements of the blood corpuscles* in the retinal capillaries. (4) *The entoptical pulse,* due to mechanical irritation of the rods lying outside the pulsating arteries. (5) *Pressure phosphenes.* (6) The *ring,* observed when the eyes are moved rapidly backwards and inwards, and which corresponds to the entrance of the optic nerve. (7) The *accommodation spot.* (8) *Mechanical optical stimulation;* division of optic nerve causes flash of light, etc. (9) *The accommodation phosphenes.* (10) *Electric phenomena.* (11) The *yellow spot:* "Löwe's ring" and "Haidinger's brushes." (12) *Spectra,* arising from internal causes, such as increased blood pressure through retina, etc.

mena of vision attracted the attention of Johannes Müller, Purkinje, Grüithuisen, Herschel, Galton, Ladd, and others. Their observations have shown that while the phenomena exist in everybody they may often remain wholly unnoticed. They are most marked in youth, and many children are accustomed to press their heads into the pillow and adopt an attitude of expectant attention towards the visions that then begin to form; they disappear usually on the approach of adult age, though sometimes not until later. Some persons can only see these subjective images when they shut their eyes in the evening; others possess the faculty of seeing them not only at night but during the day, and even with the eyes open. In some persons these images affect all possible colours; in others they appear grey on a grey background. It has also been found that for these phenomena to attract attention a certain power of observation is required; that is why they are chiefly found in intelligent persons. To concentrate the attention on them is, however, often enough to cause them to disappear (Maury, Baillarger). To a slight extent they depend on the will, and as Burdach long since noted, they may to a certain extent be modified at pleasure. He found that when hideous and terrifying faces floated before his eyes, by concentrating his attention on architectural forms he was able to see figures of a kaleidoscopic character. Another scientific observer, Dr. Weir Mitchell, remarks that from childhood he has been able to summon visions before falling asleep, but that, once present, they cannot be controlled, and change and disappear of themselves.[1]

[1] *Brit. Med. Jour.*, 5th Dec. 1896.

One or two descriptions of these hypnagogic visions by reliable writers who can speak from personal experience will serve to show their character and their intimate relation to dream-images. There can be no doubt that they are very common among children.[1] Professor C. L. Herrick, the editor of the *Journal of Comparative Neurology*, who also points this out, remarks that these hallucinations are involuntary, though they may be caused to tarry a moment by close attention, or dissipated by a sudden motion. In childhood they frequently gave him great pleasure, and in later years their vivid and charming landscapes, in natural colours, helped to mitigate the tortures of insomnia. "These views," he continues, "rarely or never contained recognisable elements from actual experience, nor could there be traced any association with real or imaginary places. Sometimes the images were of faces, and the expression varied with kaleidoscopic frequency. There are many analogies with the transformations which are occasioned in one's cloud-pictures by the changes in the forms of the clouds. The two phenomena have this in common also, that there is in each case an objective occasion—a genuine sense-irritation. In the case of the dream hallucination the irritation seems to be furnished by the congested blood-currents in the retina or within the eye-ball."[2]

[1] Weygandt briefly describes his own experiences in childhood of hypnagogic visions, *Entstehung der Träume*, p. 43; they were especially associated with fatigue. In his case there were also similar auditory phenomena, produced by closing the ears, etc. See also "Census of Hallucinations," *Proceedings Society of Psychical Research*, pp. 78 *et seq.*

[2] C. L. Herrick, "Hallucinations of Vision in Children," *Journal of Comparative Neurology*, July 1895.

Mr. Greenwood, again, has recorded the hypnagogic visions with which he has been familiar throughout life. "These faces are never seen except when the eyelids are closed, and they have an apparent distance of five or six feet. Though they seem living enough, they look through the darkness as if traced in chalks on a black ground. Colour sometimes they have, but the colour is very faint. Indeed, their general aspect is as if their substance were of pale smoke; and their outlines waver, fade, and revive (with the effect, though not the aspect, of phosphorescent limnings), so that, except for the half of a moment, the whole face is never completely or clearly visible at one time. Always of a strikingly distinctive character, these visionary faces are like none that can be remembered as seen in life or in pictures."

"In all likelihood," he adds, "Blake's visions were some such phantoms as these, presented to his eyes in broad daylight; I am inclined to think so, because his wonderful, dreadful drawing, 'The Ghost of a Flea,' is precisely such a transcript as I could have made by the score but for lack of his pictorial skill. Under my own eyelids I have seen many a face of the same awful family; some even more dreadful still, being alive and astir with animation."[1]

A psychologist of distinction, Professor Ladd of Yale, has also of late studied these phenomena by auto-observation.[2] "I verily believe," he remarks,

[1] Frederick Greenwood, *Imagination in Dreams*, 1894, pp. 14-20. Mr. Greenwood is also liable to olfactory hallucinations. "At infrequent times of fatigue an evanescent but very distinct violet scent flashes from my hands, or so I fancy." Galton also mentions a lady who was accustomed to see distinctly in hypnagogic vision showers of red roses of which she could smell the perfume.

[2] Ladd, "The Psychology of Visual Dreams," *Mind*, 1892.

"there is no shape known to me by perception or by fancy, whether of things on the earth or above the earth or on the waters, that has not been schematically represented by the changing retinal images under the influence of intra-organic stimulation." He has seen nowhere such beautiful colours as in the dark. In his own case, at all events, he considers "those visual dreams which follow almost immediately on going to sleep in a dark room originate, wholly or chiefly, in the *Eigenlicht* or essential light of the retina," and he believes that it is impossible to make a hard and fast distinction between visual perception and visual imagination in dream-life, so far as the origin of their sense-elements is concerned; in both the end-organ takes an active part. "All manner of inanimate things," he adds, "of animals, plants, and human beings, seen in dreams, may resolve themselves into the fantastic schemata of the retinal field, if we can only manage to surprise these schemata with an observing critical consciousness."

These images are in perpetual movement; they appear more or less distinct and then fade, giving place to others. Often one figure arises from another, one face from another (Marie de Manacéïne), or different flowers ceaselessly arise from a bouquet of flowers, like an endless rain of corollas (Goethe); or (as in the case of a lady mentioned by Galton) showers of red roses, as distinct as real flowers, turn into a flight of golden spangles; or, as in Greenwood's case (as a child), a shower of scintillations would turn into a flock of sheep going down hill. For the most part, however, these subjective visual images represent miniature human faces, or else faces that seem to be of natural size. Herschel correctly observes

that such faces are rarely charming or beautiful, but are usually stern, hideous, grotesque, even monstrous. The reason is, I believe, simply that in real life ugly forms predominate over beautiful forms, and that consequently in our neuro-cerebral system ugly forms must inevitably leave more traces than beautiful forms. A young girl, well known to me, instinctively adopted from childhood a method of replacing the hideous faces by more attractive faces: before going to bed she would choose some picture representing a beautiful face, and taking it with her, would gaze at it before closing her eyes, telling her mother that she did so "to have nice dreams and drive away the ugly faces that come into my eyes before I go to sleep."

Schröder van der Kolk observed that a change of position in bed would efface these visions, and also remarked that if they appear to a troublesome extent they may be dissipated by the application of a cold compress to the forehead; under the influence of this application they become pale, fade, and disappear.[1] This would seem to indicate that, to some extent, this phenomenon is due to the amount of blood flowing to the brain.

Visions in all respects similar to hypnagogic hallucination, but more abundant and more gorgeous,

[1] It may here be mentioned that, according to Delaunay (in a communication to the Society of Biology of Paris in 1882), similar influences affect dreams; thus he found that a layer of cotton wool on the head, by raising the temperature, makes dreams more vivid and intelligent; he also pointed out that dreams in the supine position are agitated, sensuous, and erotic, while he found that lying on the right side produced absurd and extravagant dreams mostly referring to remote events, while lying on the left side produced more reasonable dreams, referring chiefly to recent events.

may be produced by various drugs, more especially by mescal button (*Anhalonium Lewinii*), which is largely used by the Indians of New Mexico, and has lately been investigated by Prentiss and Weir Mitchell in America and Havelock Ellis in England. The descriptions by Weir Mitchell, a distinguished physician and careful observer, of the effect of this vision-breeding drug upon himself are so vivid, and bring before us so clearly the formation of hypnagogic images and indirectly of dreams, that they are worth quoting at some length. It should be noted that, like "faces in the dark" (which Dr. Weir Mitchell has been able to summon ever since childhood), these visions usually disappear as soon as the eyes are opened, and that will is without action on them, though suggestion seems to have some slight influence:—

"My eyes being closed, I began to see tiny points of light, like stars or fire-flies, which came and went in a moment. The star points became many, and then I began to observe something like fragments of stained glass windows. The glass was not very brilliant, but the setting, which was irregular in form, seemed to be made of incessantly flowing sparkles of pale silver, now going here, now there, to and fro, like, as I thought, the inexplicable rush and stay and reflux of the circulation seen through a lens. These window patterns were like fragments coming into view and fading.

"The display which for an enchanted two hours followed was such as I find it hopeless to describe in language which shall convey to others the beauty and splendour of what I saw. During these two hours I was generally wide awake. I was comfortable, save as to certain gastric conditions, which were not so severe as to distract attention. Time passed with little sense for me of its passage. I was critically attentive, watchful, interested, and curious, making all the time mental notes for future use.

"Especially at the close of my experience I must, I think, *have been* for a while in the peculiar interval between the

waking state and that of sleep—the 'prædormitum'—the time when we are apt to dream half-controlled stories; but as to this I am not very sure. As a rule I was on guard, with every power of observation and reflection in full activity.

"My first vivid show of mescal colour effects came quickly. I saw the stars, and then, of a sudden, here and there delicate floating films of colour—usually delightful neutral purples and pinks. These came and went—now here, now there. Then an abrupt rush of countless points of white light swept across the field of view, as if the unseen millions of the Milky Way were to flow, a sparkling river, before the eye. In a minute this was over and the field was dark. Then I began to see zigzag lines of very bright colours, like those seen in some megrims. I tried to fix the place and relation of these tints, but the changes were such as to baffle me. One was an arch of angled lines of red and green, but of what else I could not determine. It was in rapid, what I may call minute, motion.

"The tints of intense green and red shifted and altered, and soon were seen no more. Here again was the wonderful loveliness of swelling clouds of more vivid colours, gone before I could name them, and, sometimes rising from the lower field, and very swiftly altering in colour-tones from pale purples and rose to greys, with now and then a bar of level green or orange, intense as lightning and as momentary.

"When I opened my eyes all was gone at once. Closing them, I began after a long interval to see for the first time definite objects associated with colours. The stars sparkled and passed away. A white spear of grey stone grew up to huge height, and became a tall, richly finished Gothic tower of very elaborate and definite design, with many rather worn statues standing in the doorways or on stone brackets. As I gazed, every projecting angle, cornice, and even the face of the stones at their joinings were by degrees covered or hung with clusters of what seemed to be huge precious stones, but uncut, some being more like masses of transparent fruit. These were green, purple, red, and orange; never clear yellow and never blue. All seemed to possess an interior light, and to give the faintest idea of the perfectly satisfying intensity and purity of these gorgeous colour-fruits is quite beyond my power. All the colours I have ever beheld are dull as compared to these.

"As I looked, and it lasted long, the tower became of a fine mouse hue, and everywhere the vast pendent masses of emerald green, ruby reds, and orange began to drip a slow rain of colours. All this while nothing was at rest a moment. The balls of colour moved tremulously. The tints became dull, and then, at once, past belief vivid; the architectural lines were all active with shifting tints. The figures moving shook the long, hanging lines of living light, and then, in an instant, all was dark.

"After an endless display of less beautiful marvels I saw that which deeply impressed me. An edge of a huge cliff seemed to project over a gulf of unseen depth. My viewless enchanter set on the brink a huge bird-claw of stone. Above, from the stem or leg, hung a fragment of some stuff. This began to unroll and float out to a distance which seemed to me to represent Time as well as immensity of Space. Here were miles of rippled purples, half transparent, and of ineffable beauty. Now and then soft golden clouds floated from these folds, or a great shimmer went over the whole of the rolling purples, and things, like green birds, fell from it, fluttering down into the gulf below. Next, I saw clusters of stones hanging in masses from the claw toes, as it seemed to me miles of them, down far below into the underworld of the black gulf.

"This was the most distinct of my visions. Incautiously I opened my eyes, and it was gone. A little later I saw interlaced and numberless hoops in the air all spinning swiftly and all loaded with threaded jewels or with masses of colour in long ropes of clustered balls. I began to wonder why I saw no opals, and some minutes after each of these circles, which looked like a boy's hoop, became huge opals; if I should say fluid opals it would best describe what was, however, like nothing earthly.

"I set myself later to seeing if I could conjure figures, for so far I had seen nothing human in form, nor any which seemed alive. I had no luck at this, but a long while after I saw what seemed a shop with apothecaries' bottles, but of such splendour, green, red, purple, as are not outside of the pharmacies of fairyland.

"On the left wall was pinned by the tail a brown worm of perhaps a hundred feet long. It was slowly rotating, like a catherine wheel, nor did it seem loathly. As it turned, long

green and red tentacles fell this way and that. On a bench near by two little dwarfs, made, it seemed, of leather, were blowing through long glass pipes of green tint, which seemed to me to be alive, so intensely, vitally green were they. But it were vain to find in words what will describe these colours. Either they seemed strangely solid, or to possess vitality. They still linger visibly in my memory, and left the feeling that I had seen among them colours unknown to my experience.

"Their variety and strange juxtapositions were indeed fascinating for one to whom colour is more than it is to most men; nor is it possible to describe the hundredth of what I saw. I was at last conscious of the fact that at that moment I was almost asleep, and then wide awake. In one of these magic moments I saw my last vision and the strangest. I heard what appeared to be approaching rhythmical sounds, and then saw a beach, which I knew to be that of Newport. On this, with a great noise, which lasted but a moment, rolled in out of darkness wave on wave. These as they came were liquid splendours huge and threatening, of wonderfully pure green, or red or deep purple, once only deep orange, and with no trace of foam. These water hills of colour broke on the beach with myriads of lights of the same tint as the wave. This lasted some time, and while it did so I got back to more distinct consciousness, and wished the beautiful terror of these huge mounds of colour would continue.

"A knock at my door caused me to open my eyes, and I lost whatever of wonder might have come after."

Dr. Weir Mitchell found that talking in no way interfered with the visions, though they were dispelled by opening the eyes. He saw all colours but blue; his assistant, however, who also took the drug, found that he saw blue, and there were other individual differences.[1]

Closely related to these phenomena, but mainly due to the spontaneous discharges in the cerebral

[1] S. Weir Mitchell, "The Effects of Mescal Button," *British Medical Journal*, 5th December 1896; Havelock Ellis, "The Phenomena of Mescal Intoxication," *Lancet*, 5th June 1897.

centres of vision—not, as in the cases chiefly dealt with hitherto, to the action of the cerebral centres on spontaneous retinal and allied phenomena,—are the subjective visual sensations which occur at the onset of epileptic fits before actual loss of consciousness occurs; and also the closely-allied but distinct phenomena associated with migraine. In association with epilepsy, stars, or flashes of colour, especially yellowish-red flame, are very common; while in migraine the visions seen are more partial and limited. These phenomena, which have been carefully studied by Gowers,[1] are pathological, and outside our present subject.

It is the same with subjective phenomena of hearing as with those of vision. Words, tunes, and other sounds may echo, it seems in our ears, sometimes without, sometimes within the head. In disease, but without insanity, these phenomena are more marked. In disease of the labyrinth there are noises of an indefinite character, humming, buzzing, whirring, roaring. In local disease of the brain there may be the ringing of bells or the playing of music.[2]

Tarchanoff's experiments throw an interesting light on the different localisation of the subjective phenomena of hearing. He showed that if by means of two telephones we introduce into each ear sounds of absolutely equal intensity, we perceive them, not in the ears, but in the middle of the head. If the

[1] W. R. Gowers, "Subjective Visual Sensations" (Bowman lecture before Ophthalmological Society), *Nature*, 4th July 1895.

[2] Colman, *Brit. Med. Journal*, May 12th 1894. The facts and theories of auditory hallucination, as well as of hallucinatory phenomena generally, have been exhaustively studied by Parish, *Hallucinations and Illusions* (Contemporary Science Series), 1897.

sound is decreased in one of the telephones the apparent centre of sensation is displaced towards the ear which receives the stronger sound, and by continuing this decrease the point of sensation approaches still further towards the ear which receives most sound. For the success of the experiment it is necessary, not only that the initial sounds should be of perfectly equal intensity, but also that the sense of hearing should be equally keen on both sides. All those who undergo this experiment, as I am myself able to bear witness, find that the sensation of sound in the middle of the head is most oppressive and unpleasant, and we have cause to be thankful that our ears are so situated that, under natural conditions, it is impossible for sounds of equal intensity and quality to enter them simultaneously. Tarchanoff's experiments seem to suggest that the sensation of voices in the middle of the head which is often found in insanity may be due to uniform irritation of the two auditory centres, while predominance in one centre may lead to the external localisation of the sounds. Such sounds when heard by healthy persons in the middle of the head do not usually produce so painful an impression, because they are more or less weak and indistinct, but if they become more marked they begin to be fatiguing.

It may be asked whether subjective phenomena are associated with the same nervous and cerebral processes as when the organs of sense are normally stimulated. To this question an affirmative answer must be given; for the whole organism is based on the law that every reminiscence or repetition of past movement or sensation is accompanied, in the tissues and organs concerned, by changes and processes

analogous to those produced during the actual accomplishment of those movements or sensations. The existence of this law was long ago shown by Erasmus Darwin by means of a very ingenious experiment. It is recognised that more or less repose of the sensory organs accentuates their impressionability by stimuli. Darwin made use of this fact to show that the representation or reminiscence of sensations, formerly experienced in reality, is accompanied by a certain activity of the corresponding nervous apparatus. His experiment was purely subjective, and so simple that any one may repeat it on himself. Having requested the subject to shut his eyes, Erasmus Darwin told him to fix his attention on a certain well-known song or melody, and then, suddenly opening his eyes, to note to what extent the sunlight produced painful dazzling. After an interval he caused the same subject to close his eyes again and fix his mind upon some visual object, such as a friend or a well-known landscape, and then, on suddenly opening his eyes, to note the degree to which he was painfully dazzled by the light. According to Darwin, the eyes are much less dazzled by the light in the latter case than in the former. I have myself often repeated this experiment and obtained the same results. I am convinced, also, that similar results may be obtained with the other sense organs; thus cold water seems much colder to us if before immersing the hands in it we think of sensations of heat or of something without reference to sensations of temperature, while, on the contrary, it seems less cold if beforehand we concentrate the mind on impressions of cold.

Like the organs of sight and hearing, the other

organs have each their own subjective life, with purely subjective phenomena. The cutaneous nerves often give subjective sensations of heat or cold; the tingling or tickling which we feel at the extremities of the fingers when we concentrate our attention on them (John Hunter) is only a phenomenon of the subjective life of the tactile nerves. It is certain, however, that visual subjective phenomena are the most numerous and varied; and this is natural, since the organ of sight plays the chief part in the development of our psychic life.

Thus every representation or reminiscence of a sensation produces in the corresponding apparatus and tissues changes and processes which are distinguished quantitatively, but certainly not qualitatively, from the processes which are developed there during primary and "real" sensations. Direct experiment (Spirro, Beard, Preyer, Jastrow) has shown that it is enough to think of a movement to produce in the corresponding muscular group, though in an attenuated form, the contractions necessary for the accomplishment of that movement. This is ingeniously demonstrated by Jastrow's automatograph.[1]

It is due to the fact that mental activity is thus really physical activity that we experience fatigue after dreams; and that, for instance, after a dream of running it is possible to awake tired and lame.[2]

This neuro-muscular characteristic is taken advantage of by "thought-readers." In the same way, when

[1] Jastrow, "A Study of Involuntary Movements," *Am. Jour. Psych.*, 1892, p. 308.

[2] Sarah Weed and Florence Hallam, "A Study of Dream-Consciousness," *Amer. Jour. of Psych.*, April 1896, p. 406.

we think of words there are traces of the movements necessary to articulate that word, as it were the more or less imperceptible reflection of the muscular contractions necessary to form the real pronunciation of that word. Lehmann and Hansen have shown that this unconscious whispering may even be so marked as to account for some of the phenomena of "thought-transference"; and their results have been confirmed by Professor Sidgwick.[1]

It is easy to understand that the more feebly developed is the conscious side of man, and the less able he is to govern himself, so much the more marked should be the manifestation of these subjective traces in the muscles and nerves; and thus we may account for the tendency to imitation among children and savages.

This singular faculty of the neuro-cerebral and muscular organisation has great significance in moral development, if we believe, with Schopenhauer, that the basis of morality is to be found in the sentiment of pity. To feel pity, we must feel the reflection, however feeble, of the griefs and pains of others in our own nerves, tissues, and organs; and that would not be possible if we were unable to reverberate the feelings and sensations which enter into the substance of our thought; if, that is to say, we were not so organised that at the mere thought of a movement or state we did not feel throughout the body impulses and tendencies similar to those of

[1] Lehmann and Hansen, *Philosophische Studien*, 1895, xi., p. 471; Sidgwick, "Experiments in Involuntary Whispering," *Dritter Internationale Congress für Psychologie*, p. 404. Sidgwick points out that this phenomenon could only account for a particular group of the phenomena of thought-transference.

which we thought.[1] Thus the same organic aptitude which, on one side, compels our children to repeat involuntarily the movements and grimaces which they see, leads on the other hand to the development of the feeling of altruism, which is the chief basis of all morals. To pursue this matter further would, however, lead us beyond our subject.

If the essential life of the neuro-cerebral apparatus were more studied the fundamental difference between emotion and thought would be better understood than at present it is. There can, however, be little doubt that this difference may be chiefly reduced to the fact that fundamentally, as Mosso, James, Lange, Ribot, and others have shown, at the bottom of the emotions may always be found a subjective excitation of the peripheral nervous apparatus, including more or less marked vasomotor phenomena, such as redness, pallor, slowing or quickening of pulse, etc., while at the bottom of thought may also be found a subjective activity, but less in the peripheral apparatus than in the cerebral centres, except in so far as it may be associated with muscular movements, especially, for instance, those of speech, so that our thoughts are often accompanied by an echo of the words composing it.

I have discussed the subjective or essential life of the neuro-cerebral apparatus at some length, because this life forms to a very large extent the basis of dreaming, and also of imagination generally. The psychic life of sleep rests mainly on these properties of the organism. Without this subjective but involuntary life of the nerves and brain we should never have dreams nor hallucinations.

[1] See Ribot, *The Psychology of the Emotions* (Contemporary Science Series), 1897.

We thus reach the conclusion that dreams are products of the same processes which produce hallucinations, and we also recognise that the subjective life of the neuro-cerebral apparatus depends directly on the quantity of the accumulated traces in any given region of the organisation, though, as we shall see, we have also to take into account the influence of external stimuli which, more especially since the almost classical investigations of Maury, have been recognised as playing a large part in dreams. As we should expect, therefore, dreams have their chief origin in those regions of the organism which are most active during the waking state. Thus dreams are mainly made up of visual images, and if, for instance, we experience a storm in a dream, the storm is constituted by lightning, and the thunder is absent. We are justified in stating that visual dreams, complicated by auditory representations, constitute about 60 per cent. of the whole. Purely auditory dreams only occur in musicians. In 35 per cent. cases the dreams combine impressions of sight with those of touch, the temperature sense or the muscular sense; while olfactory and gustative sensations only complicate the dream in about 5 per cent. cases. In the carefully recorded results of observations by Miss Weed and Miss Hallam on 381 dreams by themselves and four fellow-students, 84.5 per cent. were visual, 67.7 per cent. were auditory, 10.8 per cent. dermal, 6.3 per cent. gustatory, and 6.9 per cent. olfactory.

Similar results have been obtained in the study of hallucinations in the sane. Not less than 62 per cent. of the 1700 persons who were found by the English Committee on Hallucinations appointed by the Society for Psychical Research to have experienced hallucina-

tions, reported visual hallucinations, while auditory hallucinations constituted 28 per cent., and tactile 10 per cent. At the same time the actual frequency of auditory and tactile hallucinations, as the Committee point out, is greater than these results indicate, since such hallucinations, being more trivial and of briefer duration, make a less profound impression and more easily fade from memory.[1]

Many years earlier similar results had been obtained with reference to the hallucinations of the insane; thus Macario found that hallucinations of sight and hearing were most frequent, and then in the order of decreasing frequency those of touch, smell, and taste. (It is generally found that among the insane the auditory hallucinations are more frequent than the visual, the proportion being estimated by some authorities as 3 to 1, by others as 5 to 1.) This general analogy is not strange when we remember that the images of dreams belong strictly to the same class as hallucinations, and are to be accounted for in the same way.

The analysis of dreams reveals that they fall into two groups—those occasioned or accompanied by peripheral excitation, and those that are due to central cerebral excitation. The former were called by Spitta *Nervenreizträume*, the latter *psychische Träume*. Miss Calkins calls the former presentation dreams, the latter representation dreams.[2]

[1] "Report on the Census of Hallucinations," *Proc. Soc. Psychical Research*, vol. x., August 1894.

[2] Nearly a century ago Hartley (*Observations on Man*) already recognised this distinction, dividing the causes of dreams into—(1) impressions and ideas lately received; (2) present state of the body; (3) association. Fenizia ("Delle Cause esterne nei Sogni," *Archivio per l'Antropologia*, 1896) subdivides the external causes into direct and

The investigation of dreaming carried on by Miss Calkins of Wellesley College, under the superintendence of Professor Sanford of Clark University, is undoubtedly one of the most important investigations into the matter which have been brought forward of recent years, and it may be well to reproduce some of the results.[1] Miss Calkins' study is based on the accurate record of the dreams of two people—herself at the age of twenty-eight and a man of thirty-two—who took notes on 55 consecutive nights and recorded 205 dreams. They did not consider themselves unusually frequent dreamers. Paper, pencil, candle, and matches were placed close at hand, and during the first weeks of the experiment an alarum clock was used to wake the experimenter at different hours of the night; this was discontinued, because in the excitement of waking through its agency connected memory of the dream was often lost. Sometimes even the effort of lighting the candle dissipated the memory of the dream. They were able to confirm the general opinion that most dreams occur during light morning sleep, though the sleep of the middle of the night is in no sense a dreamless sleep. A very close connection was found between dream-life and waking life; in only 11 per cent. of the dreams was it impossible to discover such connection.

indirect. Giessler (*Die physiologischen Beziehungen der Traumvorgänge*, 1896, p. 43) has lately furnished an elaborate classification of dreams, based not on their origin, but on their total character in accordance with whether the active or the passive process of apperception predominates.

[1] Mary Whiton Calkins, "Statistics of Dreams," *Am. Jour. Psych.*, April 1893. A similar investigation on other subjects was subsequently carried out, under the superintendence of Miss Calkins, by Sarah Weed and Florence Hallam, "A Study of the Dream-Consciousness," *Am. Jour. Psych.*, April 1896.

The dreams after four o'clock tended to be the most vivid, though there was no absolute distinction. Only a relatively small number of dreams could be shown to include any sense perception. In these the auditory dreams were of most importance, Miss Calkins remarks, since hearing is more easily stimulated during sleep than vision. Dermal sensations were comparatively frequent; smell, taste, and organic sensation rarer. The representative elements—which in a sense must be found in all dreams, since the very transformation of the sense-excitation of the presentation dream into an image requires the associative process —occurred in the following order: visual, auditory, vocal (twice as frequent in Miss Calkins, who thinks habitually with words, as in her fellow-experimenter), dermal, olfactory, general sensation. The dream always took place at the present time, and even when it concerned the home of childhood the apparent age of the dreamer was never lessened to avoid anachronism. It was, however, the unimportant events of recent life, and very seldom the seriously significant facts, which entered into the dreams.[1] Paramnesia was found to be very frequent. In most respects the subsequent observations by Miss Weed and Miss Hallam on the same lines confirmed the results reached by Miss Calkins, though they served to show that individual differences are considerable.

The comparative infrequency of presentation dreams

[1] This point was insisted on by Delage, who found that important events only enter into the psychic life of sleep when they have ceased to occupy acutely the waking consciousness. (Ives Delage, *Revue Scientifique*, 11th July 1891.) As we shall see also (p. 267), Sante de Sanctis confirms this conclusion. The opposite statement is, however, still current in psychological works.

connected with the visual sense—apart from those of subjective peripheral origin with which we have already dealt in connection with hypnagogic phenomena—has often been pointed out. When they do occur they are usually due to a bright light, especially to the morning sun. Thus Weygandt dreamt on one occasion that he was looking at "living pictures" under magnesium light, and found on awaking that the sun had just burst from behind the clouds; while Hammond mentions a gentleman who dreamed of being in heaven and was dazzled by its brilliancy, finding, when he awoke, that the smouldering fire had kindled into a bright flame, the light from which fell on his face. Max Simon also, who at one time preferred to sleep in a room without curtains in order to enjoy the morning light, found that in his early morning dreams he frequently found himself in edifices bathed in floods of dazzling light, while everything seemed animated and joyous.[1]

Professor Mourly Vold has lately investigated the dreams produced by the contemplation of various objects immediately before going to sleep. His experiments, which have been carried on during seven years, consist in gazing at a small plastic coloured object or figure, taken out of a packet of such objects, so that the subject experiences a certain element of surprise, and also in looking through coloured glass. Some 300 experiments were made. It very seldom happened that the form, size, and colour of the object all remained unchanged; the most interesting results relate to colour. A small black object on a white

[1] Max Simon, *Le Monde des Rêves*, 1888, ch. ii. The same author records a number of presentative dreams referring to all the senses as well as to the visceral sensations.

background, or *vice versâ*, produced the following various results:—(1) Simultaneous or successive, sometimes repeated, contrasts of light and dark; (2) reappearance of the colour to dream-consciousness, either in connection with an image resembling the object shown, or in connection with some other known object which was really of different colour, or else as ruling the whole dream; while the background is either of the same colour or is not perceived; (3) the colour is weakened, darkened or changed in shade; (4) the complementary colour appears as a background to the object. In the case of other colours, especially red, similar results were found, and the colour appeared in the dream, either the same, or lighter, or darker; and sometimes its complementary colour appeared with or without the colour experimented with.[1]

Dreams due to auditory stimuli are extremely numerous; the ticking of a watch, the banging of a door, a steam whistle, the fall of some article in the room above, are among the commonest sounds which may produce dreams in which appalling catastrophes seem to occur; while there are some persons who dream in response to whispered suggestions. Among dermal sensations perhaps the most remarkable dreams have been produced by hot-water bottles applied to the feet. Under this stimulus some have dreamed that they were walking on hot lava or being led by Satan over the burning marl of hell; an American gentleman dreamed that he was being tortured in the Rocky Mountains by Mexicans, who, on his refusal to

[1] J. Mourly Vold, "Einige Experimente über Gesichtsbilder im Traum," *Dritter Internationale Congress für Psychologie*, Munich, 1897, pp. 355-357.

reveal how gold could be made from copper, held his feet to the fire till he shrieked with agony, and awoke to find that the blanket which protected his feet from the hot bottle had become disarranged; a lady imagined that she was a bear who was being taught to dance by being made to stand on hot iron plates; another, that she was escaping from a burning house that scorched her feet, or that she was wading through a natural hot spring.[1] It must, however, be repeated that such presentative dreams, though striking when they occur, are by no means a frequent accompaniment of sensory stimuli. The existence of presentative dreams of smell and taste is undoubted, and was well established by Maury's well-known experiments; as an example of a dream due to smell it is sufficient to refer to the case of a doctor who had to spend the night in the very odorous house of a cheesemonger, and who heard the rats behind the wainscot before he went to sleep to dream that, for some political offence, he had been incarcerated in a cheese which shortly afterwards was invaded by an army of rats, who began to fix themselves upon his naked body;[2] while, as an example of an elaborate taste-dream, reference may be made to the young lady who, as Hammond tells us, sought to cure herself of the habit of thumb-sucking acquired in babyhood by covering the offending thumb with extract of aloes; "during the night she dreamed that she was crossing the ocean in a steamer made of wormwood, and that the vessel was furnished throughout with the same material, and the emanations so pervaded all parts of the ship that it was impossible

[1] Most of these examples are given by Hammond in the introductory chapters on Sleep in his *Treatise on Insanity*, pp. 226 *et seq.*

[2] *Jour. of Psych. Med.*, 1st July 1856.

to breathe without tasting the bitterness; everything that she ate or drank was likewise impregnated with the flavour. When she arrived at Havre she asked for a glass of water to wash the taste from her mouth, but they brought her an infusion of wormwood, which she gulped down because she was thirsty. She went to Paris and consulted a famous physician, begging him to do something which would extract the wormwood from her body. He told her there was but one remedy, and that was ox-gall. This he gave her by the pound, and in a few weeks the wormwood was all gone, but the ox-gall had taken its place, and was fully as bitter and disagreeable. To get rid of the ox-gall she was advised to take counsel of the Pope. She accordingly went to Rome and obtained an audience of the Holy Father. He told her that she must make a pilgrimage to the plain where the pillar of salt stood, into which Lot's wife was transformed, and must eat a piece of the salt as big as her thumb. During the journey in search of the pillar of salt she endured many sufferings, but finally triumphed over all obstacles, and after a good deal of deliberation reasoned that, as she had a very bad habit of sucking her thumb, it would be very philosophical to break off this part from the statue, and thus not only get cured of the bitterness in her mouth, but also of her failing. She did so"—and awoke to find that she had sucked all the aloes off her thumb.[1] But while such dreams with a presentative basis are well recognised and not uncommon, it has been questioned whether there are representative dreams of taste and smell; those who deny them attributing the dream to an undetected presentative

[1] W. A. Hammond, *Treatise on Insanity*, p. 228.

element. This question is related to what has been called the "affective memory," and the possibility of reviving such impressions without an objective basis during waking life. Ribot, who has investigated this point in sixty persons of varying class, age, and sex, finds, somewhat to his own surprise, that in not less than 60 per cent. of his subjects there was a distinct and in many cases a very pronounced ability to revive, voluntarily or involuntarily, familiar smells, such as those of many flowers, carbolic acid, etc.[1]

As regards dreams, Professor Titchener has shown that we must probably recognise representative taste-dreams;[2] and Miss Hallam found that after special precautions had been taken against objective tastes by washing out the mouth before retiring, a dream occurred involving taste-images (eating onions and enjoying them, but thinking their odour disagreeable), not real tastes.[3]

Common organic visceral sensation plays a large part in dreams: fatigue, respiration, circulation, hunger, thirst, and especially sexual desire and the pressure of a full bladder, which is frequently transformed into visions of rivers and lakes,[4] bear easily verifiable witness to this influence.

It is chiefly under the influence of functional or organic disturbance that the heart or the respiration produces dreams. Thus Max Simon relates that

[1] Ribot, *Psychologie des Sentiments*, Ch. xi. (Eng. ed., Contemporary Science Series, 1897, pp. 140 *et seq.*).

[2] *Am. Jour. Psych.*, vol. vi. pp. 507 *et seq.*

[3] *Ibid.*, vol. vii. p. 406.

[4] Weygandt, in his interesting little book, *Entstehung der Träume*, records a number of dreams in which he found that this transformation took place, and he also gives special attention to the influence of the other organic sensations named.

when at one period subject to nervous palpitation, aggravated by the use of tobacco, he frequently dreamed that he was pursued by enemies from whom he could only escape after terrible adventures, awaking to find his heart in violent action. In such a case the excessive action of the heart is attributed by sleeping consciousness to a physical cause—running—and mental anxiety, which would also cause it. In another case mentioned by the same writer, a respiratory trouble was referred by the dreamer to another person or animal; an asthmatic was wont to dream that he saw sweating horses vainly endeavouring to draw enormous burdens uphill, awaking to find that he was himself in a similar hot and oppressed state.

Professor Mourly Vold, of Christiania, whose researches on dreams are now well known, has lately devoted special attention to the part played by cutaneous and muscular sensations in dreams. He finds that the position of the limb in the dream corresponds on the whole to its real position, the other parts of the body being grouped in dreaming consciousness as they would be if the actual position of the limb occurred in waking life; so that, for instance, if the sole of the foot is curved, we dream that we are standing on the points of our toes. In the same way, if we dream of the limb being in movement, such movement must include its actual position, that is to say that in the same case of the curved sole we dream of dancing or running, or other movements requiring plantar flection.

It may happen that we transfer such position or movement from ourselves to another person, or to an animal. Such a change of personality is in accord-

ance with the psychic facts of waking life. The sight of another person's position or movement is often accompanied by a muscular movement in the observer's body, and we also have a tendency to explain by visual images what we experience by the other senses; so in dreams, dominated by fatigue, we explain our muscular sensations by images of other persons whom we suppose to be in the muscular states that we ourselves are really in.

Sometimes the limb presents itself to the dreamer as an animal or monstrosity having some resemblance to itself. This phenomenon may be explained in the same way as the dreams of changed personality just mentioned. In other cases the limb perceived by dream-consciousness gives rise to abstract thoughts having some analogy to the limb; for instance, the perception of fingers may cause dreams of objects in some respects multiples of the fingers concerned, thus involving a mental calculation during sleep. All these dream phenomena may be accounted for by an imperfect interpretation of the facts, due to a fatigued consciousness.[1]

In this connection reference may be made to the fact that there is a curious failure of connection between the movements we make in sleep and the movements that we attempt to make in dreams. An English psychologist, Mr. F. H. Bradley, has discussed the causes of this failure of the dreaming consciousness to impress movement, except in a slight degree on the tongue, the fingers, etc. He finds two reasons, though he regards these as incomplete: (1) "the comparative weakness of psychical states

[1] J. Mourly Vold, *Jagttagelser om dromme, sarlig om dromme af muskular og optisch oprindelse*, Cristiania, 1896.

in dreams;" as, however, he adds that emotional states are strong in dreams, we can scarcely say that motor ideas are weak; (2) "the vagueness of ideas of active movement;" the position of the actual body does not correspond with the position our dream ideas assume it to be in; hence there is a lack of co-ordination.[1] This lack of harmony between the psychic world and the actual physical world, as expressed in the position of the body, is no doubt an important factor.

Emotion in Dreams.—The consideration of the organic and visceral elements in dreams, and especially of the muscular element, naturally leads us to the large part played by emotion in dreams, for it is on this basis that emotion develops. Emotion plays a large part in dreams, but it is a fluctuating part, and one not easy to estimate; moreover, there are very considerable individual differences. Miss Weed and Miss Hallam investigated this point and found that of the 381 dreams by six young women students which they investigated, 29 per cent. were pleasant, 57 per cent. unpleasant, the unpleasant emotions occurring in the following decreasing order of prominence: perplexity and hurry, discomfort and helplessness, fear, anger, disappointment, shame. A strong divergence of individual experience was found. To two of the subjects dreams are chiefly a source of pleasure; one recorded half her dreams (72 out of 141) as distinctly pleasant, though sometimes experiencing vividly painful dreams. Another said, "I look forward with delight to my hours of sleep." Again, another said that she usually considered dreaming a

[1] F. H. Bradley, "On the Failure of Movement in Dream," *Mind*, July 1894.

very pleasant experience, but that during this period of dream-study the disagreeable predominated, which suggests that possibly the subjective study of dream phenomena brought about an abnormal emotional disposition.[1]

Somewhat more recently Dr. Sante de Sanctis, of Rome, has published the results of an elaborate objective investigation into the relation between the emotional content of dreams and that of the waking state.[2] He proposed to investigate two questions: (1) whether the emotions of the waking state find an echo in dreams; and (2) whether the emotions of dreams find an echo in the waking state. For this purpose he inquired into the dreams of 145 normal men, 50 normal women, 60 imbeciles and idiots, 125 criminals, 43 prostitutes, and many hysterical, epileptic, neurasthenic, hypochondriacal, and melancholic subjects, also children, besides endeavouring to make observations on animals.

With reference to the first question he divides his subjects into four groups. In the first group there was no constant relationship between the emotional state when waking and the subsequent emotional state when sleeping, although emotional dreams might be liable to occur; to this group belonged a third of the normal men, including many of the aged, a fifth of the normal women, more than two-thirds of the idiots and imbeciles, most of the criminals, and many prostitutes; these subjects are mostly poor dreamers, and some of them—for example, many idiots, many criminals, and some prostitutes—do not dream at all.

[1] *Am. Jour. Psych.*, April 1896, pp. 408, 409.

[2] Sante de Sanctis, "Emozioni e Sogni," *Dritter Internationale Congress für Psychologie*, Munich, 1897, pp. 348 *et seq.*

In the second group of subjects the emotions are sometimes repeated in sleep, sometimes not, such repetition depending on the quality of the emotion; for instance, emotions of fear reappearing, and of joy not; or emotions of sexual character reappearing, of sympathy not. To this group belong one-seventh of the normal men, one-fifth of the normal women, one-fourth of the idiots and imbeciles, and most of the criminals and prostitutes who dream. De Sanctis notes that it is curious to observe how idiots, as may be seen by observing them during sleep, always dream over again a crisis of anger experienced during the day, but never one of sexual emotion or of joy; while the murderer does not dream over again the scene of the crime accompanied by any notable emotion. In a third group are included those subjects whose waking emotions, retaining their fundamental quality, are habitually repeated in dreams; more than one-third of the normal men, and three-fifths of the normal women, belong to this group, as well as many hysterical and neurasthenic subjects. De Sanctis remarks, in regard to this group, that certain distinctions must be made. The more acute emotions of the waking state—those that are sudden and rapid—are not easily echoed in dreams; while the chronic emotions—the passions—are much more easily represented, so that in those who are in love, the very religious, the jealous, the hypochondriacal, etc., there may be continuity between the waking and sleeping emotional states. But in regard to *intensity* of emotion, De Sanctis finds, like other observers, that it is the waking emotions of medium intensity which most readily reappear in sleep, while the very severe emotions scarcely ever appear, or only at a later

date. This he regards as one of the most certain and important of his results. It does not hold good, however, to the same extent for children, among whom the more frequent and intelligent dreamers easily experience in sleep all the emotions they have gone through when awake. In the fourth and last group the waking emotions are re-echoed in dreams, but with an inverted quality; that is to say that depressing emotions are connected with exalted emotions, anger with pity, and so on. These are the dreams of emotional contrast already noted by Griesinger, Lombroso, and others. A few normal women belong to this group, and also some hysterical, hypochondriacal, and neurasthenic subjects; in normal men and in children the phenomenon was not found.

In considering whether the emotions of sleep find an echo in the waking state, De Sanctis distinguishes two varieties of cases. In the first the emotion is protracted directly into the waking state; in the second case it is merely repeated subsequently. It was easy to find examples of emotion carried on into the waking state among children, the hysterical, young epileptics, and in a few normal (more especially female) subjects. In such cases terrifying, mystical, or erotic emotions arising in sleep were continued on into the conscious life though with a varying degree of duration and intensity. Such repercussion of the emotions of sleep was found to be the rule in those idiots and imbeciles who are capable of emotional dreams, and is frequently found in minor cases of hysteria, in the neurasthenic, etc. In criminals and prostitutes it is rare; it is, however, sometimes marked in the latter in the case of emotional exaltation, especially of religious or sexual character. The sexual

emotions of dream life, especially in normal persons, have an undoubted repercussion in waking life.[1]

In summarising his general conclusions, De Sanctis remarks that the emotions of the waking state are not repeated in the dreaming state when this is from any cause reduced in activity. Further, it is a necessary condition for such repetition that the waking emotions shall be really and intimately felt; in this connection De Sanctis refers to the close connection, as shown by Lange, James, Sergi, and others, between emotion and the muscular and vasomotor systems; emotion is not a mere intellectual or simply reflex phenomenon. "Thus dream life is a revelation of individual character." But at the same time those waking emotions which are too intense, in which there has been an excessive expenditure of force, and the katabolic phase of the metabolic cycle has unduly predominated, are only with great difficulty and after a long period re-echoed in dreams. De Sanctis suggests that we may account for this phenomenon on the ground that the anabolic phase of repair and organic synthesis hinders such repetition; the emotion is, as it were, too fatigued to repeat itself. And in exceptional cases a complementary emotion appears, the antithesis of the waking emotion, having the same significance as complementary colour-images, and indicating

[1] Elsewhere (*I Sogni e il Sonno*, p. 92), De Sanctis, remarking that in various normal subjects, as well as sometimes in hysteria, he has found that sexual emotions in dreams are prolonged into waking life, refers to two of his hysterical subjects (a young man and a young woman), who whenever they experienced an erotic dream in connection with any person, on awaking continued to feel sexual attraction towards that person. That the dream was the origin and not the result of this emotion was shown by the fact that the person who excited this attraction might be wholly unattractive by age or appearance, and was sometimes even of the same sex.

a marked phase of anabolic activity. The facts altogether authorise us to conclude that there is, as Ribot has argued, a real emotional memory distinct from the intellectual memory.

These observations, as well as my own and others already referred to, show us how sleep is the resting-time of consciousness. Consciousness sleeps, and that is why we forget our pains, our sorrows, even our transgressions. It is thus also that, in the partial awakening of consciousness, when we dream we do not see what has irritated and excited us in the waking state, we do not see what has plunged us into despair or grief. In the same way we do not see what caused us joy and gladness. It is all clearly due to the very simple law that the functions and tissues which have been most energetically active during the waking state fall into the deepest repose during sleep. The ideas and feelings of grief and misfortune on which the waking man may concentrate his whole attention become in sleep as though they no longer existed. And not only, if we chance to encounter some overwhelming misfortune in our lives, do we forget it during sleep; even on awaking we do not at once recall it, we only feel something unpleasant, heavy, painful, weighing upon us; in what it consists we cannot at first recall. It needs a certain time and effort to remember the sorrow or misfortune which has spread its burden over the whole of life, and is only forgotten during sleep.

Evidently this antagonism between the sleeping psychic life and the waking psychic life preserves the human organism from many diseases by tending to remove the possibility of over-tension of the various

parts of the brain. It is evident, also, that when grief or anxiety leads to insomnia a serious mental or nervous disease may ensue. When, therefore, normal sleep disappears as a result of grief, it is prudent to obtain some hours of repose even with the aid of hypnotics.

Kant was certainly right when he said that without sleep and without hope man would be the most unhappy creature in the world. Sleep is the reality of that Lethe which, the old Greek thought, existed beyond the grave. But if we need forgetfulness anywhere it is certainly on the earth and not elsewhere.

After all that has been said concerning the direct and indirect origin of dreams in the subjective life of the neuro-cerebral apparatus, it seems to follow that this should appear the more rich and varied the greater the individual development of the subject. Observations which I have made during five years on thirty-seven persons of varying age and intelligence give the following results: (1) the number of dreams is less in persons of little intellectual development, while in persons of more active cerebral life dreams are numerous and varied; (2) the more uncultured and confined a man's mind is the more his dreams are marked by their illogical, uncouth, and rudimentary character, and the more they are limited to the repetition of what the subject really experienced during the previous days. This latter tendency was observed in 80 per cent. of the cases, while in the more intelligent subjects the dreams were never limited to a repetition of what had been lived through in the waking state, but, on the contrary, tended to introduce a less familiar background on

which unknown scenes were played. Only in a limited number of dreams of intellectual persons was it possible to trace the appearance of familiar faces, objects or scenery, and when such dreams were added to those in which echoes of real life and its cares and anxieties reappeared they only amounted to 15 per cent. cases. In explaining this greater number, variety, and originality of dreams in intelligent subjects, I must recall what has already been said at length regarding the essential or subjective life of the nervous system and brain. It is easy to understand that this subjective life must necessarily be richer and more varied, the more varied and numerous are the traces left by sensations, emotions and thoughts, such accumulated traces forming the material out of which dreams are constituted; and it is superior education and development alone which can enrich this subjective life. Thus it may be said that while the intellectual man's dreams tend to reproduce his *personal* development, the uncultured man's dreams tend rather to reproduce his *racial* development—that is to say, the general capacities of the neuro-cerebral system he has inherited from his ancestors,—while on account of the poverty of his psychic world his dreams necessarily retrace the facts which have lately occupied his waking life. In more highly developed persons the wealth of varied neuro-cerebral material makes possible not only a resuscitation of forgotten emotions and ideas, but also permits the formation of new combinations, and the creation of images which have never existed.

It must not be forgotten, however, that we each of us represent, in a certain sense, the sum of the characters of our parents and remote ancestors; and

consequently we all may reproduce in our dreams the preceding stages, not only of personal, but also of racial development. From this point of view the study of dreams may furnish important indications in clearing up different psychological questions.

To bring out clearly the connection between frequency of dreams and intellectual development, I may refer further to the results of my own inquiries as to frequency of dreaming. In persons occupied with intellectual work (professors, writers, scientific men), and in good health, the number of nights in the month without dreams oscillated between three and ten; any source of exhaustion would increase this number even up to twenty. On the other hand, in subjects belonging to the lower classes of society (cooks, servant girls, dressmakers, coachmen, soldiers, etc.) dreams were generally absent from eight to twenty-five nights during the month, varying with the individual. In short, dreams increase with the variety and activity of the intellectual life.

Since sleep is the resting-time of consciousness, a very deep sleep does not permit of dreams, while a very light sleep is usually accompanied by many dreams. Goblot has even insisted that dreams are the result of awaking. Patrick and Gilbert, in the course of the important experiments on the influence of prolonged abstinence from sleep already summarised in Chapter I., made experiments on dreaming by allowing the subject to fall asleep for periods of half a minute, one minute, three minutes, etc., and then awaking them and asking them for their dreams. No dream was obtained in any case, though if the period were less than a minute, there was a hazy dream-like memory which could not be put into

words. "These rough experiments," they conclude, "confirm the generally accepted opinion that dreams are the product of light sleep, representing, indeed, the reinstatement of consciousness after the early and profound sleep." It is not surprising, therefore, that those who dream much have a more marked tendency to sleep than those who dream but seldom (F. Heerwagen), for their distinct and numerous dreams disturb the tranquillity of consciousness; consequently a greater amount of repose is necessary, and sleep is prolonged.

Basing my conclusions on observations which I carried on for five years on thirty-seven subjects, I found that in the majority of cases dreams decrease in number as old age comes on; it is the young who dream most, and subjective visual images are also rarer in old age. Moreover, I found that that which interests us most during waking life, and chiefly absorbs our waking attention, seldom makes up the texture of our dreams;[1] during the period immediately following the deaths of those whom we love we see them alive and well, and only at a later period, when grief is becoming appeased and dissipated by time, do they appear otherwise. Hæmorrhages, and diseases which exhaust the organism, as well as all depressing emotions, tend to diminish the number of dreams. In the same way, according to Johannes Müller, subjective visual images are specially clear and frequent in good health and tranquillity. I found that conversation, phrases, and separate words only occurred in 8.5 per cent. of the dreams examined, grouping together those in which either the subject

[1] This, as mentioned on p. 257, has already been pointed out by *Delage* and Miss Calkins, and is confirmed by De Sanctis.

or interlocutors spoke;[1] distinguishing the words pronounced by the subject from those spoken by others, the latter were found to form only 1 per cent., while visual images form 85 per cent. There is a well-known tendency in dreams, as was long since pointed out by Maury, for the perpetration of bad puns, sound leading sense, as happens frequently with the insane, idiots, and children. In this respect, also, we thus see an analogy between the sleeping state and enfeebled conditions of the waking state of consciousness.

It is not superfluous to remark here that in our dreams we scarcely ever see our own faces; if this happens it is usually due to gazing in a mirror on the previous evening; so that beautiful women, who indulge long in such contemplation, ought to see themselves in dreams much more frequently than ordinary mortals. The same is true of hallucinations; deiteroscopy, or hallucinations in which one sees oneself, are very rare.[2] It is true that Goethe once had such a hallucination in full daylight in the open country, but there is reason to suppose that in youth he was somewhat preoccupied with his own person.

It may be asked what difference there is between the psychic activity of sleep and the conscious psychic

[1] This proportion of dreams with a verbal element may be abnormally small. Miss Calkins found that for one of her two subjects (male) the dreams in which words occurred were 77 out of 147; while in the other subject (female) the proportion was still larger, 110 out of 165. (*Am. Journ. Psych.*, April 1893, p. 322.)

[2] Thus the Psychical Society's Census of Hallucinations only contained seven such cases out of a total of nearly 1,300 visual hallucinations, and the only example quoted in detail in the report is that in which a young lady of twenty-four, in robust health, saw her own "double" approach with "a charming smile."

activity of waking life. Is there a difference, and if so, will it enable us to elucidate some of the obscure points in psychic life? In dreams we are often the mere spectators of images and scenes which unroll before us, and it is but rarely that our own personality, the "ego," intervenes. We all accomplish acts in dreams, and experience feelings, which are in complete contradiction with our deepest convictions and incompatible with our character. Good and gentle persons may be transformed in dreams into murderers and rascals. Why? It seems that in this drowsy state of consciousness the personal qualities of the man are gradually effaced, to give place to the activity of a neuro-cerebral system inherited from more or less ancient ancestors with all the representations, feelings, thoughts, and acts corresponding to that activity.[1] In dreams we live over again, as it were, what our ancestors felt and thought. I might quote the dream described by Pierre Loti in his *Livre de la Pitié et de la Mort*, but every one, on reflection, may discover analogous dreams in his personal life during sleep. In general, as Spiess and many later writers have pointed out, we have in dreams little or no notion of our own personality. Such vagueness and confusion in the notion of personality is always associated with undeveloped states of consciousness. Thus children, whose consciousness in the early years of life is still weak and undeveloped, cannot understand the significance of the pronoun "I"; instead of saying "I" they use more difficult words, for instance, their own Christian names, and speak of themselves in the third

[1] At the same time we may also invoke these contrast phenomena which are a well-recognised factor of the dreaming life, and which have already been mentioned (p. 268).

person. The same phenomenon is observed in idiots (Broussais), and in certain forms of insanity. Every enfeeblement or abolition of consciousness in man involves the enfeeblement or abolition of the personal *ego*. Thus whenever the clear idea of one's own personality intrudes into a dream, it is an indication of a marked awakening of consciousness. In fairly deep sleep conscious personality is abolished, and the images of dreams pass before us strange and unknown, without relation to us. We can scarcely recall dreams of this kind, and if we sometimes remember them, it is later on, sometimes in the course of the day. Such reminiscence of dreams occurs in accordance with the psycho-physiological law (already referred to in another connection), by which we sometimes hear, afterwards, the sounds of human speech which have ceased, the melody which no longer vibrates, the clock which struck some seconds since; they had passed unperceived, though not unregistered, because then consciousness was otherwise occupied. The neuro-cerebral system retains the traces of the impressions which strike it, and in the absence of other exterior impressions, these may revive under the sole influence of that voluntary impulsion which is, as it were, given by consciousness. In such cases consciousness may be compared to a master who returns to his property after a temporary absence; he carefully examines all the changes, the additions, the transpositions which have occurred during his absence, and notes what he finds.

I have already insisted on the large part taken in the constitution of dreams by the traces left by sensation in the brain and nerves. If we look attentively at an object and then close the eyes, we

still see it, sometimes clothed in the same colours as in reality, as a positive image, sometimes in complementary colours—the light turned to dark and the dark to light—as a negative image; and we have all in childhood tried to look at the sun and remember the coloured negative images which floated before us afterwards. Mourly Vold has shown, as we have seen (p. 258), how these positive and negative images can be experimentally obtained in dreams. We have still to ask whether the images of dreams produce a corresponding reflection in waking life. Dream emotions, already referred to (p. 268), produce an echo in waking life. Is it the same with dream-images?

It sometimes happens in the waking state that subjective impressions leave positive and negative images. Thus Féré has stated that he is able to visualise, for example, a red cross so vividly that it is followed by a negative image showing the complementary greenish colour. Meyer, also, states that with closed eyes he evoked in the middle of the dark visual field the image of a silver stirrup, and on opening his eyes continued to see before him the same image, only dark instead of light. He observed similar phenomena after dream-images. Thus he dreamed that he was walking on the edge of a dark canal when he was suddenly attacked by a light yellow little dog that barked and tried to bite him. The dreamer awoke in fear, and on opening his eyes continued to see the dog-image of his dream, except that its colour was dark instead of light.[1] Burdach tells us in his *Physiology* that he dreamed that his daughter, who had recently died, was taken

[1] H. Meyer, *Physiologie der Nervenfasern*, pp. 239 *et seq.*

up into heaven, and on awakening continued to see with open eyes his daughter's form rising in the air. Grüithuisen dreamed that he saw lightning, and on awakening he actually saw a feeble luminous line which then gave place to a sensation of special blackness. On another occasion he dreamed that he was looking for a book on the shelves of a library; he then awoke, and before his open eyes the backs of the volumes continued to pass from left to right.[1] A similar case has been recorded by Strümpell of a lady who dreamed that a coffin was in her room, and that a mass of blue flowers was lying on it; awaking at the moment she continued to see both coffin and flowers.

It has happened to me on several occasions to see with open eyes, on awakening, the images of my dreams; and under such circumstances I have observed that the chief condition for preserving the dream-image on awakening is to avoid changing the direction in which the eyes are turned. It thus appears that we may continue to see the image we saw in dream if we awake at the moment of a distinct and vivid dream, and if this awakening is produced without shock or movement, the eyes retaining the direction that they had in sleep when gazing at the image. Consequently the cases in which one may best see the dream-image on awakening are those in which the dreamer is aroused by the influence of the dream itself, and on awakening is neither deafened by noise nor dazzled by light, so that on opening his eyes he naturally remains in the same position which he occupied during the interrupted dream. The slightest movement of the head or eyes immediately dissipates the image.

[1] Grüithuisen, *Beiträge zur Physiognosie*, pp. 232 *et seq.*

Studying the traces left by dreams, I have convinced myself that not only are the colours seen in dreams modified on awakening according to the laws of contrast, but that the same change is observed in the entire character of the dream-figure. Thus a face which seen in dream wears an expression of sadness or reproach, if still seen with open eyes on awakening sometimes seems joyous or smiling. It is evident that this change represents the formation of a negative image, though purely psychic, the given expression or emotion being replaced, according to the law of contrast, by the opposed and as it were complementary emotion. Thus just as the emotions of the day may find their complementary emotions in sleep, so the emotions of the night may find their complementary images on awakening.

Those dreams which, as it were, cross the boundary which separates the world of dreams from the world of waking life usually produce a very strong impression, for we do not like to find ourselves face to face with the independent creations of our neuro-cerebral system, not fully realising the subjective life of the nerves and brain-cells, and when brought into the presence of the creations of this subjective life we are liable to be terrified as well as surprised. I shall myself never forget the impression produced by a dream of the image of Christ, crowned with thorns, which befell me when seriously ill. The face of Jesus was admirably reproduced, and full of sweet and profound sadness; but suddenly the expression began to change, and in my dream I was so astonished that a mere painted image could thus change its physiognomy that I awoke, and yet still continued to see the divine face before me with an expression of sad-

ness on it, slowly changing into a mild and joyous smile which at last completely effaced its earlier melancholy. In this case awakening took place in the morning when it was quite light. Another dream which vividly impressed me happened in the autumn of 1894. I imagined that the bell rang, that the front door was opened by the servant, and that some one noisily entered, then that my study door opened, and that the imperial Russian standard was brought to me as I sat in an easy-chair. It was inclined towards me, and I distinctly saw the two large golden tassels hanging from the staff while the flag floated down unfurled, so that the two-headed eagle could be plainly seen, as well as the three national colours, white, yellow, and black. The appearance of the national flag in my house surprised me so much that I awoke, and on opening my eyes still saw it before me with the three national colours, the eagle, and the two golden tassels, while the staff was slightly bent towards me. In this case the after-image was positive, and the vision disappeared without change of colours. It was still night, and the bedroom was in absolute darkness.

The preceding facts are, I imagine, enough to show that dream-images leave more or less profound traces in the neuro-cerebral system, and that consciousness, as we awake, may from these traces reconstitute our dreams. This labour of consciousness is considerably facilitated by the law of association, by virtue of which all the sensations and ideas grouped in time and space possess a tendency to reciprocal reproduction when any one of them reappears. Thus the reminiscence, or rather posterior consciousness, of dreams is possible, because the subjective activity of the neuro-

cerebral apparatus leaves traces in its turn, traces which may revive according to the laws of association and under the influence of concentrated attention. We have seen, moreover, that the notion of the *ego* is more or less enfeebled during sleep, and that this enfeeblement may even go as far as complete annihilation.

Cause and Effect in Dreaming.—One of the characteristics of the psychic life of sleep is that attention ceases to be voluntary and becomes purely reflex; that is to say, it attaches itself to the strongest idea or sensation. In this respect the sleeping man resembles the child, the savage, or the idiot, in whom attention seems also to be reflex and inaccessible to the impulsion of will. All that we see in dreams is submitted to us under the fundamental conditions of time and space, but the third fundamental law of psychic life, which naturally obliges us to find a sufficient cause for each act and phenomenon, is almost completely absent from the psychic life of sleep. In dreams we observe a certain succession in time and space, but we seldom note the relation of cause and effect.

The reason of this is simple: this law of cause is, as Helmholtz justly points out, a purely logical law of thought, and therefore it is impossible except when consciousness is active. In the preceding chapter I have pointed out that many people pass their lives in a sort of perpetual half-sleeping state due to enfeebled consciousness, and in such persons also we find a similarly enfeebled notion of causality. Folk-lore shows how feebly cause and effect have been understood in the past and are still among the less intelligent classes and races. The

homœopathic rule, *similia similibus curantur*, is not a recent discovery. In old days medicines were generally given according to their resemblance to the disease, though this resemblance was then sought exclusively in external qualities, and not in the action of the medicine. Thus the hearts of carrots were administered in jaundice, the colour being that presented by the patient suffering from the disease; for heart disease the fruits of *limocarpus anacardium* were prescribed from their exterior resemblance to the human heart; for kidney disease, seeds which resembled the kidneys, and so on (Fraser).

The error that the remedy must resemble the disease in order to effect a cure seems to me inspired by the same tendency which compels us during sleep, and during enfeebled states of consciousness generally, to associate everything which presents some common resemblance, for example, words according to their sound,[1] and images according to some accidental and external resemblance. The same tendency is also observed in the uneducated, and very markedly in the insane.[2] A number of popular superstitions rest on an accidental resemblance. For instance, in Russia many people believe that to light three candles on a table is a bad omen, presaging a death in the house. This superstition is explained when we remark that in Russia it is the custom to place three candles around a dead body, one at each side of the head and one at the feet.

[1] Thus Maury recorded a dream which was connected by the words, *pèlerinage, Pelletier, pelle;* another by the words, *Chardin, jardin, Janin;* and another was thus bound together, *kilomètre, kilos, Gilolo, lobélia, Lopez, loto.*

[2] See, for instance, Lombroso, *The Man of Genius*, pp. 176 et seq.

In dreams and hallucinations we may find still more unexpected approximations; any resemblance in colour or form is enough to associate images which are altogether heterogeneous.

The absence of causality in dreams explains also the well-known fact that we are not easily surprised in dreams (Spitta, Winter); and in so far as conscious thought and logic are absent, astonishment is impossible; for it can only appear when a phenomenon is in direct contradiction with all the laws of logical thought.[1]

For the same reason children and the uneducated show extreme credulity; they accept every absurdity because they are unable to ascertain whether or not the phenomenon in question is in accordance with the logical conditions of thought. An accidental resemblance suffices to associate incompatible things; the simple succession of the most heterogeneous phenomena leads to a supposed relation of cause and effect. It is to this same mental level that we are all reduced in dreams. It may be remarked also that children, the aged, and even adults when enfeebled by disease, cannot always distinguish dream life from real life. It was thus with Caspar Hauser, who at seventeen or eighteen was on the same mental level as a child, and during the first years of his life among men was, it is said, unable to dis-

[1] It is important to point out, however, that it is quite incorrect to assert, as Spitta and others have asserted, that no surprise at all is felt in dreams. As Miss Calkins justly remarks, we may experience surprise, but it is soon lulled by the vividness of the impression. We have to recognise "the possibility of dream-thought active enough to explain dream-images, but not keen enough to deny their externality." Having accepted the dream-image, we are capable of reflecting on it very reasonably.

tinguish real life from his dreams, which he regarded as actual events.

In this connection, also, I may refer to the dreams in which the chief part is played, not by images, but by speech. As was remarked more than fifty years ago by Philip, the words we utter in dreams are never so absurd as the visions that appear to us. This is natural when we remember that speech is the chief instrument of logical thought. In dream discussions—which for some authors constitute a direct proof of the duality of the brain—our opponent often corrects our own mistakes and brings forward more cogent arguments than we have been able to advance.

Dreaming and Insanity.—We have already seen that on awakening from a deep sleep we often see the images which formed part of our dreams, just as also we may see in dreams the images which floated before our eyes before falling asleep. And we are entitled to conclude that dreams and hallucinations are at bottom phenomena having the same origin.

It is not therefore surprising that the images of dreams, and dreams themselves, may be transformed into hallucinations, and that it has long been known that there is a distinct relation between dreaming and insanity. Dreaming may, as Wundt puts it, be called a "normal temporary insanity."[1] Diderot often insisted upon this connection. In the last century a Geneva physician recorded the case of a young lady who dreamed that her step-mother was approaching with a dagger to kill her, and was so deeply impressed that she thus became the victim

[1] Cabanis (*Rapports du physique et du moral*, Paris, 1824, t. ii. p. 359) gives Cullen the credit of being the first to point out the similarity between the phenomena of dreaming and those of delirium.

of a delusion which rendered her insane. As Wright has lately shown also, the insanity of the poet Cowper to some extent owed its character to a dream. Falret, Moreau of Tours, and Brierre de Boismont have all described hallucinations that began in sleep and were finally accepted. Féré gives a case of hysterical paralysis following a dream.[1]

In all such cases the process is similar; first there is a vivid or often-repeated dream; then this dream attains a despotic empire over the subject's attention; and he is at last dominated by the images or ideas engendered by the dream. I may quote the following case: A young man of twenty-two was driving out with his wife when by chance a child fell down before the carriage and a wheel passed over it, crushing the head; the young man was seized with horror, and the same night he started up in his sleep exclaiming, "Save the child! save the child!" This was repeated every night, sometimes several times during the night, with piercing shrieks. It was always very difficult to awaken him, and when awakened he could remember nothing. He told his wife, however, that he was tortured by frightful dreams, and that the image of the injured child never left him. This went on for two years, when epileptic attacks began to appear and he rapidly fell into a state of complete dementia. In another case a young man began to be tormented during his sleep by dreams in which he imagined he was being strangled. He thought his comrades were

[1] Féré, "A Contribution to the Pathology of Dreams," *Brain*, vol. ix. (1887), p. 488; also *Pathologie des Emotions*, p. 153; Faure, "Etudes sur les rêves morbides," *Arch. Gén. de Méd.*, May 1876; Richter, *Arch. f. Psych.*, xiii. 1; Ph. Chaslin, *Du rôle du rêve dans l'evolution du délire*, 1887.

playing tricks on him. To prove that it was not so they induced him to sleep alone and lock the door. The dreams continued, and then he came to the conclusion that he was tormented by the Devil—to whom we so often attribute our misfortunes and errors. Finally he became insane. Persons thus obsessed by dreams are usually with difficulty awakened, and often have a tendency to fall into an intermediate state between waking and sleeping. They thus possess at the outset a feeble and inactive consciousness which needs strong impressions from the external world to enable it to distinguish the subjective from the objective. In the absence of such strong impressions these persons are liable to regard their own sensations as real and external.

In the same way, during the delirium of fever it may happen that the patient's consciousness is so enfeebled by disease that he becomes delirious as soon as he closes his eyes or as soon as the room is darkened, while the delirium ceases when the eyes are opened or the room is lit up. The same phenomenon has been observed in healthy subjects with reference to hypnagogic hallucinations. Thus Maury observed a servant girl who was obliged always to go to sleep with a lighted candle in her room, for she found that the light drove away the horrible and grimacing faces which regularly tormented her in darkness; and Brach, who was himself subject to hypnagogic hallucinations of general sensation and of touch—imagining as he fell asleep that his body was indefinitely large and heavy, extending towards the stars, and then that it was shrivelling up to a point—found that a lighted candle was sufficient to dissipate all his false sensations; so that we are justified in

believing that light may influence not only apparitions, but also hallucinations of the other senses.

All the sensory impressions from the environment have, however, a salutary effect even in insanity, and Baillarger has observed that the hallucinations of the inmates of asylums often disappear under any influence which interrupts the monotony of their lives. In this way hallucinations often cease during the doctor's visit. Trélat has recorded, also, that when two hundred insane persons had on one occasion to be removed from the Salpêtrière and Bicêtre to other asylums, they were all provided with new clothes, and this, together with the preparations for departure, interested them so greatly that they forgot their morbid hallucinations and delusions; so strong was the impression that even attacks of mania which had been occurring periodically for from ten to fifteen years, and fell due at this time, failed to manifest themselves.

It has been observed even in completely normal subjects, who on account of eye disease have been placed in a dark room with bandaged eyes, that a kind of delirium may appear. Schmidt-Rimpler, who points this out, remarks, however, that it appears exclusively in persons belonging to the lowest social classes or in the very aged; that is to say, in those only whose consciousness is weak or enfeebled. Such delirium, due to sudden removal from the ordinary luminous excitations which normally stimulate the brain, was always violent, and the patient sometimes forgot where he was and what was happening. But as soon as the bandage was removed and the patient brought into the light the delirium vanished, not to appear again.

It may be added that since the subjective life of the neuro-cerebral system is also connected with the circulation, it sometimes happens that hypnagogic images, hallucinations, and delirium generally may depend to some extent on the position of the body; Pinel described a case in which auditory hallucinations appeared as soon as the patient lay down and disappeared as soon as she rose, and Schröder van der Kolk found that in some cases delirium came on as soon as the patient's head was lowered.

Dreaming and Alcoholic Insanity.—The analogy between dreaming and insanity may be easily understood after all that has been said concerning the resemblance among all states of enfeebled consciousness, and it is not necessary to insist upon it. Something may, however, be said about one form of delirium—the *delirium tremens* produced by alcohol—which appears to have a specially close relationship to dreaming. This was first pointed out by Lasègue.[1] He remarked that in the delirium of alcohol visual hallucinations predominate, that these are varied and incessant, constantly changing into new fantastic shapes as the figures in a kaleidoscope, and singularly resembling a dream. But the chief point in Lasègue's argument was that, unlike the sleep of ordinary insanity, from which the prevailing delusion is mostly absent, the sleep of the alcoholic subject is crowded with similar images, and, moreover, that these are really the constant and regular starting-point of the disorder. Lasègue distinguished three periods in the evolution of the delirium: the first, in which it only

[1] Lasègue, "Le Délire Alcoolique n'est pas un délire mais un rêve," *Arch. Gén. de Méd.*, Nov. 1881. Féré has also shown the analogy, "La Médecine d'Imagination," *Progrès Médical*, 1886.

appears at night, during sleep; the second period, in which the patient is delirious awake as well as asleep, the images and ideas being the same whether awake or asleep; and a third stage, during which the delirium passes into a confused sleepy condition which usually goes on to convalescence. He considered the whole process as a pathological sleep. His position was no doubt somewhat excessive, for if we accepted it we should probably have to include all forms of insanity under the same heading.

Lately, however, some interesting fresh light has been thrown on the subject. The visual hallucinations of alcoholic subjects, as is well known, are extremely varied. Rats, mice, spiders, beetles, fleas are very common and almost characteristic, while flames and blood are very frequent;[1] most frequent of all, however, are probably visions of snakes and worms.[2] These have often been attributed to *muscæ volitantes* in the eyes. Dr. Davis, however, has been investigating the subject in the alcoholic wards of Bellevue Hospital, New York, with the ophthalmoscope, and has brought out some interesting facts. In every one of the sixteen cases examined, the blood-vessels of the retina were found to be abnormal. Instead of being pale and almost invisible, as in their

[1] See, for instance, Magnan, *Étude sur l'Alcoolisme*, 1871.

[2] De Sanctis has found that visions of small animals (microzooscopic visions) are most frequent in alcoholic cases, those of large animals (macrozooscopic) in hysterical cases, and makes the following remarks:—"Macrozooscopic dreams appeared in 62 per cent. of dreams belonging to the group of severe hysteria, and in 35 per cent. of the group of slight hysteria. In the alcoholic cases I have studied I have found, on the other hand, that microzooscopic dreams constantly prevailed. Such zooscopic visions in general occur, according to Liepmann, in 70 per cent. of the alcoholic; Delasiauve only observed them in a fifth of his cases, and Näcke in a third of his."—De Sanctis, *I Sogni e il Sonno*, p. 184.

ordinary condition, they were dark, almost black, with congested blood. The blood-vessels of the retina, which are small and semi-transparent in health, assume such a prominence that they are projected into the field of vision, and their movements seem like the twisting of snakes. Of course, with a brain half paralysed or partially excited, the active circulatory condition of the fundus of the eye may assume to the diseased imagination almost any form.[1]

It thus seems probable that alcoholic delirium has its rise in an exaggerated and pathological form of precisely those subjective activities of the organs of sight which, as we have already seen, play so large a part in the causation both of hypnagogic phenomena and dreams. At the same time it is probable, as Dr. F. W. Brown has suggested, that similar subjective sensations arising from a pathological state of the other sensory organs may also play a part in giving shape to the hallucinations of alcoholic delirium. Bugs, ants, mice, and rats are common hallucinations, but they are generally found *first* on the body and then afterwards in the room and on the furniture. The appearance first on the body can be explained on the supposition that the hallucination was created by a cutaneous sensation of itching, which would quickly lead, through imperfect cognition, to the conception of a bug or an ant, and then be secondarily manifested as a visual hallucination. The primary hallucination of snakes could thus be brought about through misinterpretation of a *cutis anserina*, or goose-flesh, which sweeps coldly, wave-like, and rhythmically over a portion of the body. The sensations proceeding from the skin would thus help to give shape

[1] *New York Medical Times*, 1896.

to the visual sensations arising from the congested vessels of the retina.[1]

Morbid Dreams.—Pathological dreams were long since divided by Macario[2] into three groups: prodromic dreams, which precede disease; symptomatic dreams, which occur in the course of disease; and essential morbid dreams, in which the dream constitutes the main feature of the disease.

To illustrate prodromic dreams I will quote a few examples. A man who had spent some time in Egypt, and there suffered severely from inflammation

[1] It may be added that other explanations of this phenomenon have been offered. Thus Dr. F. W. Mann considers that there may be an atavistic element, and asks: "May not the explanation lie in the facts of nascent consciousness? We know that stimuli cannot be co-ordinated without some ganglion through which they are brought into relation. In effecting this co-ordination the ganglion must necessarily be subject to the influences of each stimulus and must undergo a succession of changes. This action and its reaction, implying perpetual experiences of resemblances and differences, constitutes, according to psychologists, the raw material of consciousness. Therefore, as a corollary of this process, Herbert Spencer asserts that 'as consciousness is developed some kind of instinct becomes nascent.' That there is a nascent instinctive dread of the serpent in man and monkey is obvious. There is every reason for it. The early history of our race abounds with record and tradition of that internecine strife between man and the serpent. We find the serpent permeating all his mythology, a chief feature of his legends, inscribed on his monuments, engraved on his symbols, and worshipped as his god. Even before this period the dread of the serpent may have been implanted in our human neuroplasm. Dr. A. E. Brown recently made some experiments in the Philadelphia Zoological Gardens, and found that monkeys who, born and reared within the gardens, had never seen a reptile, yet exhibited great fear and curiosity when a snake was placed in their cage. An alligator or turtle caused no surprise whatever. Other animals like the ox and the hog were either perfectly indifferent, or manifested no fear of the snake."

[2] *Du Sommeil*, etc., 1857, pp. 86 *et seq.* Macario was probably the first writer to deal with this subject from a scientific standpoint. It has been fully dealt with also by W. A. Hammond, *A Treatise on Insanity*, 1883, pp. 234-261.

of the eyes, some ten years later, after he had long been living in another country, began to dream nearly every night of different places in Egypt and scenes of his old life in that country. He was absolutely unable to explain the strange frequency of these Egyptian dreams, which continued persistently. At last inflammation of the eyes showed itself and served to explain the dreams. It was evident that for some time the premonitory symptoms of the disease had existed, although unperceived in the waking state, and hence by force of association the sensation of discomfort from the eyes produced dream-images of the old life in Egypt, where the previous attack of inflammation had taken place. Again, a man dreamed that he was bitten in the leg by a mad dog; on awaking he felt nothing; later, an ulcer appeared on the spot where he dreamed he had been bitten. Macario dreamed that he had a severe pain in his throat; on awaking he felt well, but a few hours subsequently was attacked by a severe quinsy. M. Terte, a minister of justice under Louis Philippe, dreamed that he had an attack of apoplexy; three days later he died suddenly of that disease. In other cases persons have dreamed of deafening tempests, or of becoming dumb, and on awaking have found that they actually are deaf or dumb. Insane obsessions are sometimes preceded by such dreams; thus Hack Tuke records the case of a gentleman who dreamed that he committed a criminal offence and was arrested; he awoke, relieved to find it was only a dream, but a few days later he became insane and actually committed the offence in question.[1]

[1] Tuke, art. "Dreaming," *Dict. of Psych. Med.*

All such dreams may be simply explained by the fact that during sleep dreaming activity surrounds with appropriate images the changes which are developing in the sleeping man's consciousness, and which are caused by the pathological process which is beginning to take place in the organism. In the waking state, and amid the massive sensations, ideas, and feelings aroused by the impressions of the outer world, the faint beginnings of these pathological processes are unnoticed; they first make themselves felt to sleeping consciousness. Thus the first evidence of approaching paralysis may be a very slight degree of numbness which in the active waking state is not noticed. During the tranquillity of sleep it is perceived and magnified, as is customary to the dreaming activity, and the patient (in this case one of Galen's patients) dreams that his leg is turned to stone.

It must, however, be acknowledged that in some cases the association between the disorder and the dream-image is not so evident. Thus many people when threatened by a gastric or intestinal attack dream of seeing fish. The late Professor Sergius Botkin told me that he had found this coincidence in his own case, and I have myself several times found it in the case of a young girl who is well known to me. Some have supposed that the sleeping consciousness receives an impression of the elongated shape of the stomach or intestine; but such a supposition is easier to make than to prove.

Symptomatic dreams, or the characteristic dreams which belong to a definite disease, have not yet been carefully investigated. The most detailed and elaborate investigation yet made has been by Dr. Sante de

Sanctis, who has devoted a volume of two hundred pages to the sleeping activities in epilepsy and hysteria, investigating 53 cases of grave hysteria, 45 of slight hysteria, and 90 cases of epilepsy, omitting those of a dubious nature. He sets out to inquire whether, not only in insanity but also in hysteria and epilepsy, there is what may be called a "nocturnal syndrome" or group of characteristic signs belonging to the disease and assisting in the diagnosis and prognosis. He has accumulated a large number of detailed facts bearing on this point, and comes to the conclusion that in hysteria and epilepsy there is such a nocturnal syndrome, of which the culmination in epilepsy is the attack, and of which the various preliminary or subsequent phases include such phenomena as hallucinations, hypnagogic dreams and nightmare, forming a variable whole difficult to determine, but of undoubted reality. The nature and frequency of dreams and cerebral over-activity during sleep also constitute a special symptom of hysteria. The dreams of epileptics, he found, are more liable to be affected by the weather than those of the hysterical, so that in this respect epilepsy merits its ancient name of *morbus astralis* or *lunaticus*. They are also less complex and briefer than those of the hysterical, whether terrifying or merely indifferent in character. The dreams of the hysterical are often real romantic dramas, while in the epileptic they are but panoramas, visions, rapid scenes. In the hysterical macrozooscopic dreams and dreams of contrast prevail; while in the epileptic subject the most frequent dreams are those of a lascivious character, or those in which he feels his own physical personality profoundly changed, dreams evidently due to changes

in the cœnæsthesia such as are not uncommon in epileptics in the waking state. The dreams of the hysterical often influenced their waking life and the course of the symptoms, but only in six cases was it found that the disease was thereby aggravated; in more than half the cases (25 out of 45), however, the humour and conduct during the day were influenced by the dreams, and De Sanctis thinks that this probably occurred in many other cases. At the same time, De Sanctis points out that there are, properly speaking, no specific epileptic or hysterical dreams, only a certain relation between the nature of the sleep and dreams and the evolution of the disease.[1]

Essentially morbid dreams include all those phenomena which are now commonly called nightmare, and which were in early Christian times attributed to demons, incubi and succubi, although Oribasius in the fourth century, and many other physicians, argued that they were pathological phenomena.[2]

It is probable that various distinct phenomena are commonly included under the name of nightmare. Thus the severe form called *pavor nocturnus*, or night-

[1] S. de Sanctis, *I Sogni e il Sonno nell' Isterismo et nella Epilessa.* Roma, 1896.

[2] The belief in the spiritual reality of incubi as the demons of nightmare still persists. The following instance may be mentioned, as it is also an example of a rare form of morbid symptomatic dreaming. A young girl of defective intelligence in the asylum at Werneck was subject to epileptic fits, only occurring during sleep, in which she opened her eyes with a fixed stare, stretched out an arm or a leg stiffly, and invariably dreamed that a man lay beside her and asked her to lie further off, as he wished to occupy her place. The nurses, considering it a case of demoniacal incubus, advised her to say a prayer, which, however, failed to evade the attack. (Lehmann, *Allgem. Zeitschrift für Psychiatrie*, Bd. li., Heft 2, 1894.)

terror, and occurring only in early life, is a distinct affection. It appears only between the second and eighth year; there is always a neurotic family history, and convulsions have been a frequent precursor. At the same time there may be no other sign of ill-health. In night-terrors the onset is marked by a sharp cry; the child sees some object which inspires him with terror, he springs from his bed, crouches in a corner and protests vociferously. He recognises no one, and in the morning has no recollection of what has happened. The same vision is likely to reappear in future attacks; and it is held by some that this affection is allied to epilepsy.[1]

In its ordinary forms nightmare is associated with a disturbed sleep, and especially with dyspepsia; fulness of the stomach and the eating of indigestible food late in the evening are among the best recognised causes of nightmare; it acts mechanically by interfering with the action of the diaphragm, and so indirectly with the circulation of blood in the brain. If the collar of the night-dress is too tight, or if the pillow is misplaced so as to bring the head into a wrong angle in relation to the body, the circulation may likewise be interfered with and nightmare produced. Sensations of discomfort from any part of the body—heart, respiratory or digestive organs, bladder, ovaries (it is specially common about the time of menstruation)—may originate nightmare. Fatigue, emotional excitement, anxiety, a long walk, going to the theatre, a school examination, may also bring it on.

The physical symptoms in nightmare, as described

[1] Coutts, *Medical Standard*, May 1896.

by Hammond,[1] who has devoted special attention to this subject, include groaning, flushing of the face, neck, and chest, cold perspiration, especially on the forehead, sometimes a general trembling of the whole body; the respiration is particularly disturbed and the breathing sometimes stertorous. It is remarkable that, except for some slight irregularity due to respiratory disturbance, the pulse is rarely affected.

The psychic symptoms are chiefly made up of fear together with a feeling of utter helplessness. The dreamer is engaged in a struggle and is seeking to bring his muscles into action, but they are powerless, and he feels helpless to escape from his foes. These foes consist of all sorts of animals or demons. One dreamer is mentioned who was visited almost nightly by a great black walrus which appeared to roll off a huge block of ice, crawl on to the bed, and throw itself on his chest. Another was tormented by an animal, half lion and half monkey, which seated itself on his breast and fastened its claws into his throat. In other cases there are no images, but only the sense of being placed in a dangerous position, or subjected to a torturing operation. Thus one lady imagines that she is poised on the top of a high mast and in extreme danger of falling off, while another thinks that she is being dragged through a keyhole by some invisible power.

After all that has been said in previous pages with regard to the large dependence of the phenomena of sleeping consciousness on the state of the organs and tissues, it is easy to understand that when a group of persons are placed under uniform conditions their dreams also may be more or less uniform. Such

[1] *Op. cit.*, pp. 250 *et seq.*

collective dreams have been recorded by various medical observers. Thus Nudow relates that during a tempest that arose one autumn night nearly all the travellers in a Dantzig hotel had the same dream, imagining that a carriage full of passengers had noisily driven up to the door of the hotel; each by turn in the morning asked the servant who had arrived during the night, and each was surprised to hear that no one had come and that no carriage had been seen. Burdach, who refers to this incident, mentions that he himself one night, while staying at an inn during a stormy night, dreamed that he was driving in the blackness of night along the edge of a steep precipice, and in the morning found that his travelling companion had had the same dream. A much more remarkable observation was made in the last century by Laurent, who was surgeon-major in one of Latour d'Auvergne's regiments, when garrisoned at Palmi, in Calabria.[1] Orders had been received to march at once to Tropea to oppose the landing of a fleet which threatened that part of the country. It was June, and the troops, about 800 in number, had to march about forty miles. They started at midnight and reached their destination at seven o'clock in the evening, resting but little by the way and suffering greatly from the heat. When they reached Tropea they were the last battalion to arrive, having come from the farthest point, and were assigned the worst barracks, which would normally accommodate only half the number of men. They were crowded together on straw on the bare ground, and being without covering were unable to undress. The build-

[1] Laurent, *Journal de Médecine*, 1818; also Parant, art. "Incubi," *Grand Dict. de Méd.*, vol. xxxiv.

ing was an abandoned abbey, and the inhabitants predicted that the men would not be able to stay there, as the place was frequented by ghosts. "We laughed at their credulity," says Laurent, "but what was our surprise to hear about midnight the most frightful cries issuing from every corner of the abbey, and to see the soldiers rushing terrified from the building. I questioned them in regard to the cause of their alarm, and all replied that the devil lived in the building, that they had seen him enter by an opening into their room, in the form of a very large dog with long black hair, and, throwing himself upon their chests for an instant, disappear through another opening in the opposite side of the apartment. We laughed at their consternation, and endeavoured to prove to them that the phenomenon was due to a very simple and natural cause, and was only the effect of their imagination, but we failed to convince them, nor could we persuade them to return to their barracks." The following night they refused to go to the barracks unless the officers went also. "I went there," Laurent continues, "at half-past eleven, with the commanding officer; the other officers were distributed in the several rooms. We scarcely expected to witness a repetition of the events of the preceding night, for the soldiers had gone to sleep, reassured by the presence of their officers, who remained awake. But about one o'clock, in all the rooms at the same time, the cries of the previous night were repeated, and again the soldiers rushed out to escape the suffocating embrace of the big black dog. As may be supposed, we had seen nothing." The men returned to Palmi on the following day, and the phenomenon was not again repro-

duced. Laurent was of opinion that the forced march on a very hot day, by weakening the men and fatiguing the organs of respiration, had predisposed them to these attacks of nightmare; while the constrained position in which they were obliged to lie, the fact of not being undressed, and the bad air aided in the production of the phenomenon. It may be added that there was probably an element of suggestion also, since the men were told that the place was haunted.

To understand these cases of collective dreams, and indeed the phenomena of dreaming generally, we have to bear in mind the ordinary law of association by resemblance, which is in operation during sleep and affects sensations and feelings as well as ideas. Serguéjeff cites the observations of an unknown author concerning certain associations between a definite sensation and a whole series of ideas and thoughts. In these observations the subject had during a certain period of his existence always used the same perfume; then changing his whole surroundings and mode of life, for a long time he used another perfume and left the first always unopened. If during this period he was without dreams of this early period he would hand over the early perfume to his servant, telling him on some following morning when he found him asleep to moisten the corner of the pillow, taking care at the same time not to awake him. Every time this was done the sleeper dreamed of those past conditions of life during which he had used that perfume. This observation is of value as showing the possibility of provoking at will groups of dream-images; it is, however, in harmony with other well-known facts, usually discovered accidentally; many such facts have been cited in previous pages.

The Dreams of the Blind.—We have had such frequent occasion to discuss the close connection between the subjective life of the sensory organs and the psychic life of dreaming that there is interest in considering what happens in those who are blind, or who have been deprived of other senses or of their limbs.

This matter was first investigated, and with much ability, so long ago as 1838 by Heermann.[1] His observations, which were made on 100 subjects, showed that in the blind generally dreams are rarer than in normal subjects, and that visual sensations and ideas were completely absent in those cases (fourteen in number) who had lost their sight previous to the fifth year. In cases of blindness beginning between the fifth and the seventh year the subjects felt for the most part uncertain; but all those who became blind after the seventh year had dream-vision. The less intelligent, however, rarely saw dream-visions. He found that they were maintained in some cases for over fifty years after blindness came on; then, however, they faded. (Other inquirers state that, as a rule, dream visions die out after about fifteen years of blindness.) He demonstrated by post-mortem examinations that the dying-out of dream-vision was not due to degeneration of the optic nerve, for he found that the optic nerve atrophied in about twenty years, but that dream-vision continued beyond this period.

More recently Professor Jastrow, of Wisconsin, in a valuable and interesting paper, has published the results of a similar investigation (begun in ignorance

[1] G. Heermann, "Beobachtungen und Betrachtungen über die Träume der Blinden," *Monatsschrift für Medicin*, etc., i. pp. 116-180, Leipzig.

of Heermann's earlier researches) on two hundred persons of both sexes in the institutions for the blind at Philadelphia and Baltimore.[1]

Jastrow examined fifty-eight cases of total blindness (including under this head those upon whom light has simply a general subjective "heat-effect," enabling them to distinguish between night and day, between shade and sunshine, but inducing little or no tendency to project the cause of the sensation into the external world). Of these, thirty-two became blind before completing their fifth year, and *not one* of these thirty-two saw in dreams. Six became blind between the fifth and the seventh year; of these, four had dreams of seeing, but two of them so seldom and with some vagueness, while two never dreamed of seeing at all. Of twenty persons who became blind after their seventh year all had dream-vision. The period from the fifth to the seventh year is thus marked out as the critical one. Before this age the visual centre is undergoing its elementary education; its life is closely dependent upon the constant food-supply of sensations, and when these are cut off by blindness it degenerates and decays. If blindness occurs between the fifth and the seventh years, the preservation of the visualising power depends on the degree of development of the individual. If the faculty is retained, it is neither stable nor pronounced. If sight is lost after the seventh year, the sight-centre can, in spite of the loss, maintain its function, and the dreams of such an individual are hardly distinguishable from those of a seeing person.

Jastrow also sought to find out whether in the

[1] J. Jastrow, "Dreams of the Blind," *New Princeton Review*, July 1888.

partially blind dream-vision remains clear or is impaired, a question to which the reply was less satisfactory. Of twenty-three who described their dream-vision as only as clear as waking sight, all became blind not later than the close of their fifth year; while of twenty-four whose dream-vision is more or less markedly clearer than their partial sight, all lost their full sight not earlier than their sixth year. The age that marks off those to whom total blindness carries with it the loss of dream-vision from those whose dream-vision continues is thus the age at which the sight-centre has reached a sufficient stage of development to enable it to maintain its full function when partially or totally deprived of retinal stimulation. The same age is also assigned by some authorities as the limiting age at which deafness will cause muteness (unless special pains be taken to prevent it), while later the vocal organs, though trained to action by the ear, can perform their duties without the teacher's aid. This, too, is assigned as the earliest age at which we have a remembrance of ourselves. This Jastrow directly tested by obtaining one hundred answers to the question, "What is your earliest remembrance of yourself?" The average age to which these memories go back is 5.2 years, seventy-nine instances being included between the third and the sixth years. At this period of child development—the centre of which is about the close of the fifth year—there seems to be a general "declaration of independence" of the sense-centres from their food-supply of sensations.

Jastrow, with the assistance of Professor Stanley Hall, has also investigated the dreams of those who are at once both blind and deaf, more especially

Laura Bridgman. Sight and hearing were as absent from her dreams as they are from the dark and silent world which alone she knew. The tactual-motor sensations, by which she communicated with her fellow-beings, and through which almost all her intellectual food was brought, were also her mainstay in dreams. This accounts for the suddenness and fright with which she often woke from her dreams; an animal which to us would first make itself seen or heard, to her was present in dream only when it touched and startled her. Language has become so all-important a factor in civilised life that it naturally is frequently represented in dreams. We not only dream of speaking and being spoken to, but we actually innervate the appropriate muscles and talk in our sleep. This was the case with Laura Bridgman. "Her sleep seemed almost never undisturbed by dreams. Again and again she would suddenly talk a few words or letters with her fingers, too rapidly and too imperfectly to be intelligible (just as other people utter incoherent words and inarticulate sounds in sleep), but apparently never making a sentence." So, too, all the people who entered into her dreams talked with their fingers; this was already present at the age of twelve, four years after her first lesson in the alphabet.

A study of this kind, as Jastrow remarks, leads to the investigation of the peculiarities of imagination in the blind. "It is not difficult to understand that the blind are deprived of one powerful means of cultivating this faculty, that the eye is in one sense the organ of the ideal. Their knowledge is more realistic (*handgreiflich*), and so their dreams often lack all poetical characteristics, and are very common-

place. Ghosts, elves, fairies, monsters, and all the host of strange romance that commonly people dreams, are not nearly so well represented as in the dreams of the sighted. What is almost typical in the dreams of the latter is unusual in the dreams of the blind. Many observe that such dreams grow rare as they outgrow their youth, which is probably also true of the sighted. When the blind dream of ghosts they either hear them, and that usually not until they are close at hand, or they are actually touched by them. A blind man, describing a dream in which his friend appeared to him, said: 'Then I dreamt that he tried to frighten me, and make believe he was a ghost, by *pushing me down sideways*,' etc. By some the ghost is heard only; it has a rough voice and its bones rattle; or it pursues the victim, humming and groaning as it runs." Jastrow found that hearing is the chief sense of the blind in sleeping as in waking life; the tactual-motor sensations, which play a large part, and which some have put first, he finds to be second. A blind boy who dreams of Alexander the Great putting the Gauls to flight hears the thunder of cannon but sees no flash; another dreams of the Judgment Day mainly in terms of hearing; he was drawn to heaven by a rope (such as he knew fastened to an exercising pole), and heard trumpets sounding and voices singing; a young man dreamed that his mother was dead, knowing this by the cold touch of the body, and so on.

More recently Hitschmann, who has been blind from the age of three, though he is still able to distinguish between light and darkness, has given an account of his own dream-life, and has discussed the

subject generally.[1] He never dreams of seeing, and considers that the blind in general have weaned themselves from their deficiency and feel themselves in an accustomed natural condition. They have not that painful longing for light which is poetically ascribed to them. Naturally their dreams are compounded of the other sensations, especially the impressions of hearing. The blind dream of voices, by which the persons of their acquaintance are recognised, just as the seeing often dream of faces and figures. Sometimes animals, especially dogs and birds, seem to the sightless to have human voices and to be gifted with speech. A blind man who travelled home once a year used to dream of the journey by rail. In this case the dreams were made up of rumbling wheels, whistle of the locomotive, feeling of fresh air through the open windows and the smell of food sold at the station. While the dream world of the blind is poor in sensory images, it is rich in abstract phenomena. It is characteristic of their dreams that the dreamer often feels as if he were a spectator at a theatre; he seems to witness novels, dramas, or philosophical lectures, such impressions apparently coming through the sense of hearing.

There is an interest, also, in this connection in studying the dreams of those who are born without arms or feet. Heermann mentioned such a case in which the man always dreamed of walking on his knees as in waking life. It is said that in other cases of similar deformity dreams of walking normally have

[1] F. Hitschmann, *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, October 1894. The same writer has also discussed the æsthetic emotions of the blind, *Vierteljahrsschrift für wissenschaftliche Philosophie*, Bd. xvii. 3.

occurred; if well established such cases might be of considerable significance.

Those who have lost their arms or legs follow much the same laws as those who have lost their sight. Professor James, investigating the experiences of 185 persons who had undergone amputation, found that three-fourths still experienced sensations in the lost limb, but in the others it had faded out after hours, weeks, or years. One man of seventy still felt distinctly the leg which he had lost at the age of thirteen; while another experienced such vivid sensations in the lost foot that he found himself getting out a pair of scissors to cut the toe-nails.[1] So likewise in dreams the amputated do not imagine that they are using crutches but that they are walking on their feet, with this difference, that the limb in time may appear to become shorter until the toes seem to join the stump. This hallucination has been specially noted in cases in which the wound healed rapidly without complication. If there has, on the contrary, been much suppuration and painful cicatrisation the patient receives a mass of new sensations which seem to familiarise him with the changed form of his limb. A man who lost his right arm at the age of twenty-three still dreamed of it at forty. Observations on amputations at an early age are not numerous, so that it is difficult to say precisely at what age this hallucination begins; the case is mentioned of a boy who lost his leg at ten and was still dreaming of it some years later.

Dreaming in Criminals.—The study of dreams in defective organisms leads us to ask whether the

[1] W. James, "The Consciousness of Lost Limbs," *Proceedings of American Society for Psychical Research*, vol. i, p. 249.

dreams of criminals show any special characters. Several writers have referred to the peaceful sleep of criminals, and Despine long since remarked that no sleep is so like the sleep of the just as the murderer's. Lately, however, De Sanctis has more carefully examined this question with his customary thoroughness and psychological insight.[1] Observations were made on criminals belonging to Central Italy, first on 40 criminals at Orvieto taken indiscriminately, and subsequently on 85 criminals, including 24 women, chosen from the worst subjects, real criminal types, mostly condemned for crimes of violence; except in the Orvieto group they were without obvious nervous disease. Taken altogether, it was found that 29 dreamed often, 64 dreamed occasionally, and 32 never dreamed. But while only 5 of the Orvieto group (40) of men (including many affected by nervous disease) never dream, 24 of the latter group (61) of more severe criminals never dream. All but 3 of the women dream. All those who dream (with the exception of the neurotic subjects) say that in freedom they dreamed much less than in prison; this is true both of men and women, being due to the greater idleness of prison life, and perhaps also to the influence of changed conditions of diet, etc. Those who never dream are among the very worst criminals, and are often mentally deficient, and nearly all of them are in prison for life. The three women who never dream are one who was found guilty of cruelty to her own child, an old recidivist, and a young intelligent and pretty girl guilty of murder.

[1] Sante de Sanctis, "I Sogni nei Delinquenti," *Archivio di Psichiatria*, 1896, fasc. v.-vi.

With regard to the emotional character of the dreams, De Sanctis found that they were chiefly of a terrifying and especially religious character, of persecution, falls from a height, quarrels, liberation from prison, scenes of gaiety, and very often subjects connected with the sexual sphere; while the dreams without emotional tone refer to the trivial events of the day, etc. It is customary for a criminal to reply, when asked what he dreamed about, "I dreamed of freedom;" this merely means that his dreams refer most frequently to the period before incarceration.

De Sanctis inquired specially into the interesting question of the relation of criminals' dreams to their crimes. Of the 93 criminals who dreamed he found 22 who sometimes dreamed of their crimes; of those, 11 dreamed simply of the deed, without any emotional accompaniment; 11 experienced emotional dreams of their crimes. Of the 21 women-dreamers, 4 had such dreams without, and 2 with emotion. A few of the murderers very frequently see their victims in dreams without any emotion; in one of these cases the murderer dreams that his victim reproaches him. The young woman guilty of ill-treating her child never has emotional dreams and never sees her child in dreams.

Thus criminals dream rarely and but little, and the greatest criminals least of all; in this, as De Sanctis remarks, they resemble idiots. Even on the nights following the crime they sleep deeply and peacefully, although their sleep is, of course, liable to be disturbed by special causes, such as illness, and is specially liable to be modified by the weather. In a few cases the sleep of criminals may be tormented, as was that of Macbeth; and there is also an emotional and hysterical

criminal type; but this is very rare and scarcely represented at all among criminals of the worst class. They are real imbeciles so far as the feelings are concerned, and in part also as regards intelligence.

The Utility of Dreams.—At what age do children first begin to dream? There can be little doubt that dreams occur even during the first days of extra-uterine life, but their domain is circumscribed by the limited sensations and experiences of the new-born child. I may refer to the fact that movements of suction occur during sleep even in the first weeks of existence. In babies six months old I have observed the apparent occurrence of more complicated dreams, followed by smiling. The conscious narration of dreams cannot of course appear until the period, varying in different individuals, when the child gains the faculty of speech. Moreover, memory does not extend back to the earliest years of childhood; few persons remember farther back than from the seventh to the fifth year; a few can recall events that occurred when they were two or three years old; perhaps the earliest case recorded is that of a woman who could recall all the circumstances of her first walk by herself at the age of eleven months. Such memory supposes a remarkably happy organisation of the central nervous system.

We should carefully attend to the sleep of childhood, and the character and frequency of the dreams. There can be no doubt that heavy or restless sleep often announces the approach of illness. If children groan or cry out in their sleep or are subject to the night-terrors already described (p. 296), there is a serious derangement of normal equilibrium calling for medical attention. In the same way absence or rarity

of dreaming in children is a bad sign. It must be remembered also that mental over-strain, from which so many, both children and adults, suffer in our time, often shows itself first in the dreams.

But apart from their indirect medical utility, which we have already dealt with in connection with morbid dreams, they have a directly salutary influence in so far as they serve to exercise regions of the brain which in the waking state remain unemployed. I have elsewhere referred to the injurious effects of monotony in sensations, thoughts, and emotions; in this respect dreams are extremely useful, for they bring a certain variety into the most empty and uniform life. To the poor they may thus in part take the place of mental recreation, as Davidson, Burdach, Novalis, and others have pointed out. Novalis remarks that dreams serve as a breastplate against the monotony and triviality of real life, and declares with truth that without dreams we should grow older much more rapidly. And without dreams, it may be added, not only should we grow older more rapidly, but we should find life more wearisome. Old age comes on more swiftly in those who are mentally undeveloped—that is, in those who dream little; a fine intelligence and an energetic consciousness constitute the best protection against the destructive influence of time.[1]

[1] Mr. Greenwood, independently, has insisted at some length (*Imagination in Dreams*, pp. 78-88) on the function of dreams in enlarging our imaginative knowledge of the possibilities of life. "If," he remarks, "beyond the entertainment it affords there be any use in literature, any use in the novelist's pictures, the poet's revelations, the dramatist's embodiment and display of human feeling, it must be something to have the stage erected in our own breasts, the scene our own lives, the stir of emotion and passion our own in situations of acute trial and intense meaning."

To appreciate rightly the utility of dreams we must remember around what commonplace surroundings the lives of many people pass, painted, as it were, grey on a grey background; so that even during a long period of such existence they can retain few memories worthy of attention. But they still retain an involuntary dramatic and imaginative power in sleep. "It would be no great exaggeration to say," as Maudsley remarks in his admirable and oft-quoted chapter on dreaming, "that the dramatic power of a dunce in dreaming exceeds that which is displayed by the most imaginative writer in his waking state." I have myself known an old woman of sixty who preserved the memory of a dream as the happiest recollection of her whole long life. She would become radiant with animation as she narrated that sacred dream which had thrown its single ray of splendour on an existence made up of petty miseries and petty satisfactions. In that memorable dream she had been to the palace of the Tsar himself, and she never tired of telling the dream which represented the one poetic element in a monotonous life of labour and trouble. Even among the cultured and educated there are perhaps not many who have not at some period experienced a more or less prolonged feeling of joy and satisfaction after a vivid dream of a beloved person, an emotion which is often still stronger if that person is no longer living.

It is, moreover, a common experience that the thoughts we have not been able to control so as to be able to take a definite resolution often become clear and defined after a night's quiet sleep. This influence of sleep is embodied in the popular wisdom of many nations. A Russian proverb says that the

morning is the time to make up one's mind; and there are German, French, English, and Italian proverbs to the effect that the morning hour has gold in its mouth, that we must always sleep over an important resolution, and that the night brings counsel. That this is not always merely due to the results of repair of fatigue seems to be indicated by the account given by Macario of a young lady, a music teacher personally known to him, who studied music amid frequent interruption and difficulties; she told him that she had observed that whenever she dreamed of studying a piece of music which she was actually studying she found in the morning that she knew it far more perfectly than when she went to bed; thus it appears to have been not the rest but the dream which assisted her.

Franklin told Cabanis that he had been helped by dreams in many of the affairs of life, and a great many men of science, poets, philosophers, musicians, and others have declared that they received important ideas and suggestions in dreams (Burdach, Lotze, Voltaire, Condillac, Condorcet, Coleridge, Tartini, Macario, and many others).[1] Some of these facts,

[1] Schleyer, the inventor of Volapuk, we are told by Post, conceived that language in a dream: "Quick perception, retentive memory, and untiring industry enabled him to master, during thirty years of study, the grammatical structure of over fifty languages and dialects. The mass of material brought together by Schleyer became unwieldy and irreducible. In part it was chaotic. The pieces were there, but they were the pieces of a puzzle. The heterogeneous parts were so numerous that selection from them to form a homogeneous whole caused a wearisome work, ending in frequent and ever-changing confusion. One night this patient student retired for sleep. Before him, in orderly array, trooped the necessary characters, forms, and processes out of the bewildering assemblage of the fifty languages which had confused his waking thoughts. The vision ended: he rose from his bed, found

which have been recorded too often to be repeated here, are undoubtedly reliable, though others rest on vague and more uncertain evidence. And certain authors (N. Lange, Helmholtz, Griesinger, Brodie, Maudsley, Beneke, Herbart, Fechner, etc.) have in this way found ground for believing that much that we honour in literature, science, and art is the direct result of mental work during sleep, and due to unconscious cerebral activity.

The Significance of Dreaming.—There is still something to be said as to the general significance of dreaming in relation to psychic life generally. And, first, we may ask whether a complete absence of dreams is possible. The solution of this question is surrounded by difficulties, and the results of various observations are not altogether harmonious. Some authors have asserted that sleep is impossible without dreams, while others consider that dreaming is an exceptional, even pathological, incident in the life of sleep.

We have seen that sleep represents the repose of the individual consciousness, as determined by the circumstances of his life at the present moment. In sleep the man may therefore cease to live in the present, but may think, feel, and judge as he thought, felt, and judged at some earlier stage in his development.[1] He becomes conscious of the old

light and paper and pen, and recorded on a single sheet of note-paper his language, which to-day is substantially what was revealed to Schleyer on that night of vision."

[1] Giessler (*Die physiologischen Beziehungen der Traumvorgänge*, p. 36) enumerates various points in which there is a resemblance between dream-life and the life of children. Sully, in the course of an eloquent article on "The Dream as a Revelation" (*Fortnightly Review*, March 1893), has brought forward the same point:—"Here, again, we

mental scars, which, as Seymour Taylor remarks, are left on the psychic organism by every impression of the past, and are only revealed in dreams, in the delirium of fever, the epileptic aura, or other unusual physiological force, or abnormal pathological influence.[1]

appear to see a reversion to a primitive phenomenon. Absorption in the bodily life is the characteristic of infancy before the growing intelligence has been attracted and held by the ever-changing spectacle of the external world. It is probable that a child or an animal feels its hunger with an overpowering intensity of sensation, of which grown persons know next to nothing. A slight change of temperature is for the infant a stupendous calamity. When asleep we may be said to go back to this primitive animal immersion in bodily sensation. The all-important groundwork of our life once more engages our thought, we hear the heart beat, and feel the incoming and outgoing of the breath; we rejoice with the weary limb in its repose, with the chilled extremity warmed by an effusion of generous blood, or, on the other hand, suffer with the over-laden stomach or with the cramp-seized muscles. By restoring the bodily factor of consciousness to its primitive supremacy our dreams may properly be described as revelations."

[1] "What is known as a mental impression I should prefer to call a 'mental scar,' which, like ordinary scars in ordinary tissues, depends for its durability on the depth and intensity of the force occasioning it. And as all bodily scars except the most trivial are ineradicable, so I think all mental impressions—save those which are so light and transitory as to barely constitute a mental process—are permanent. It is no argument against this view that memory fails and that forgetfulness occurs. The imprint is there, and the 'mental scar' is not necessarily obliterated because we cannot for the moment find it. A patient of mine in severe delirium went through a long speech of a character in one of Bulwer Lytton's plays. On recovery he could not repeat a word of the speech, nor has he at any time subsequently, although repeatedly pressed by me to do so, been able to recollect any part of the speech, and cannot understand how he ever recited it. In my own case, during the height of scarlet fever, I recollected a peculiarity in the hair of a relative who died when I was a child. I have ascertained that this peculiarity did exist, but I was certainly in ignorance thereof until the stimulus of a fever recalled the mental impression. It is all very well for the poet to say,

But not only are the bounds of personal consciousness extended vaguely in sleep so as to cover all the past life of the sleeper. It is even possible to hold that consciousness is still further extended, and that the consciousness of the species, and even its predecessors, may be represented in the psychic organism and reappear in sleep. Professor Stanley Hall, the distinguished American psychologist, has argued with some force that on this supposition only can we understand the phenomena of morbid fears. Protesting against the tendency of Weismannism to limit the full recognition of evolution in the field of psychology, he points out that "however different soul and body may be, they have been associated like twins from the first, so that if there have been metempsychoses there have been parallel metasomatoses, that as organisation of brain has been found increasingly complex, we must look well to it that our conceptions of soul do not leave it mean, parasitic, or even epigenetic, but make it no whit less involved and venerable than the body, with rudimentary and vanishing organs like it, and like the living soma, subject to incessant change, to know the laws of which is the goal of psychology."[1] All that our ancestors lived, felt,

> 'Yea, from the table of my memory
> I'll wipe away all trivial fond records,
> All saws of books, all forms, all pressures past,
> That youth and observation copied there;'

but the more one studies cases like the above the more one will tend to the conclusion that the scar, the instinct, the stain, or whatever simile we may use, is fixed permanently on our mental tablets."—S. Taylor, "A Case of Intellectual Aura or Dreamy State," *Lancet*, 9th August 1890.

[1] "A Study of Fears," *Am. Jour. Psych.*, 1897, p. 244. Some years ago, Laycock ("A Chapter on some Organic Laws of Memory," *Jour. Ment. Science*, July 1875) concluded "that when men or

and suffered during countless ages of time, all that they condensed into images and faculties and definite movements has been passed on to us, not, indeed, as such, but in the shape of latent capacities and possibilities inherent in our neuro-cerebral system. And thus it may well be during sleep, when the immediate personal consciousness is inactive, that these latent characters of the psychic organism inherited from our remotest ancestors stir within us, and fill with strange images and unforeseen desires our inner world. Every one sometimes dreams of acts, thoughts, and desires in direct contradiction with all his whole character, his convictions and tastes; he dreams of things which cause him horror when awake and fill him with disgust. The best and most honest of men sometimes execute in their dreams the most dishonest and cruel deeds. How can we explain such dreams?

The explanation that I would offer lies in the sleep of personal consciousness. As soon as a man's personal consciousness is profoundly lulled and consequently inactive, all the tendencies transmitted by his farthest ancestors which were latent in his waking consciousness now begin to revive. The more atavistic the character of the dream the more paradoxical and strange it must appear to waking

animals manifest impulses of an unaccountable character, and experience pleasures, and sympathies, and pains, and antipathies, which seem to be out of relation to their culture and personal experience, or to the culture of the family or the race, whether in dreams or when waking, the source of these must be found in long past or ancestral memories reproduced according to the law of reversion; but being out of relation to the external conditions of the individual, and not, therefore, developed by reflex action due to external impressions, they are not revived as knowledge."

consciousness. It is true that on awaking consciousness can with little difficulty reconstruct the texture of dreams from the traces they have left; but this is only possible for dreams that are not in direct contradiction with personal consciousness—that is to say, those originating in the ideas and feelings of one's own personal psychic world. It is only with great difficulty that consciousness can reconstruct the tissues of a dream formed of elements foreign to personal consciousness and traceable to elements that are latent during waking consciousness. Reminiscence is impeded because waking personal consciousness no longer recognises itself in such dreams, and is unable to recognise and group the traces which seem to bring a barbarous dissonance into the psychic world. Such retrospective and atavistic dreams seem therefore mostly to occur towards morning, because then consciousness is more refreshed and better able to realise the strangeness of the dream images, which themselves contribute to arouse it still further. In such a case a good and peaceful man may awake in horror with forehead bathed in sweat from a dream in which he has been transported into some strange and antipathetic environment in which he had committed a barbarous and cruel deed, not altogether abnormal, but fully possible in the far past of humanity.[1] We have all had such dreams, and half-

[1] Greenwood has vividly described such a dream, in which the absence of horror may be noted:—"Many years ago I dreamed of having killed a man by throwing him from the verge of an old unfrequented quay. The murder itself did not come into the dream, which began (according to my waking remembrance) just after I had turned from the scene. In my case horror there was none, the dream was of guilt alone; and whenever I review that vision of myself stealing away through the old streets that bordered the quay (it was early

awaking consciousness has reassured us with the thought that they are but dreams; while in other cases the atavistic dream so offends consciousness that immediate and complete awakening is provoked. In the presence of such Maudsley may well exclaim that if we were held responsible for our dreams, there is no man living who would not deserve to be hanged.

Thus these retrospective or atavistic dreams plunge us into the long past periods of the development of the general consciousness of the species, and if they do not produce a sufficiently strong impression to cause at least a partial awakening of sleeping consciousness, we retain no recollection of them and have no means of reconstructing the images and feelings of which they were formed. Indeed, to remember and reconstruct dreams generally requires a certain amount of practice, and all those who have had occasion to study dreaming know that it is developed and strengthened by exercise (Nelson). The ordinary conditions of contemporary life do not lend themselves to the development of this practice, and thus many people pay so little attention to their dreams that they are not conscious of having dreamed at all. In the same way, in the waking state, we may see an object, forget it, and maintain that we have never seen it. I have already had occasion to remark that it is only under morbid conditions, among the uneducated, idiots, criminals, etc., that it is common to find even an

morning, and the streets were bathed in a thin, clear, slanting light), and when I recall my sensations, the whole mind of me an abyss of listening silence, my very footsteps seeming noiseless, and a wide environment of distance standing between me and every passer-by, I believe I really do know the awful solitude a murderer feels."

apparent absence of dreams, whether real or not. Even among the blind, who are probably not such good dreamers as those who see, Jastrow found that among 183 persons who answered the question, "Do you dream?" the percentage of those answering "No" was only 1.1, while 7.6 per cent. dreamed every night, the women more frequently than the men.[1]

On the whole, high mental development is always associated with a greater amount of dreaming, since it involves greater impressionability of the neuro-cerebral system. Comparisons in this respect can, however, only be made between persons of the same sex and the same age, for these conditions notably modify the impressionability and the stability of the traces of dreaming activity. Not only are women greater dreamers than men of the same age, and unmarried women more than married women (Heerwagen), but age is a very important factor, the young being much greater dreamers than the aged. Jastrow found among the blind a decline in the prevalence of dreaming as we pass from the period between five and nine years to the period between ten and fourteen years, a slighter decline in the next five years, and then a gradual decrease. Heerwagen, while pointing out also the frequency of dreams in the young, finds that dreaming reaches its greatest intensity between the twentieth and the twenty-fifth years.[2]

Heerwagen noted that in frequency of dreaming male students form a class between men and women,

[1] For a summary of the data with regard to sexual differences in nature and amount of dreaming, see H. Ellis, *Man and Woman*, pp. 263 *et seq.*

[2] F. Heerwagen, "Statistische Untersuchungen über Träume und Schlaf," Wundt's *Philosophische Studien*, Bd. ii.

and in evidence of the fact that personal development and occupation help to determine the quality of dreams, I may refer to Maudsley's statement that after absorption during the waking state in scientific work involving severe and systematic efforts of thought, dreams may become more regular and logical in their texture. Such an influence is, it need scarcely be added, liable to be counteracted by the other influences which we have found to affect the psychic sleep, such as the phenomena of contrast and the frequent tendency of dreams to deal with the past rather than the present.[1]

The various facts and considerations brought forward in preceding pages lead to the conclusion that the absence of dreams, real or apparent, is a phenomenon of unfavourable significance, since it indicates probably a feebleness of the traces of sleeping psychic life, and certainly a poverty of mental associations, and consequently of the psychic life generally. My own observations convince me that the absence of dreams is often a premonitory symptom of mental or nervous disease. Macario long ago noted that in dementia there is a complete absence of any evidence showing the existence of dreams. In old age, moreover, dreams are almost exclusively composed of reminiscences dating from childhood and youth; for, as is well known, as mental energy departs, it is the latest acquisitions of the neuro-cerebral system that are first lost.

[1] Heermann mentions the case of a blind man who never dreamed of the hospital in which he had been living for eighteen years, and to which he had been brought shortly after he became blind. Jastrow observed, again among the blind, that 42 persons found recent dreams more frequent, 27 remote dreams, and in 22 they were equally frequent.

It has already been pointed out that our reminiscences of the past may be more vivid in the sleeping than in the waking state. The various forms of paramnesia, or delusions of memory, as noted by Miss Calkins and others, abound in dreams. This abnormal heightening of memory, which occasionally occurs during sleep, has led to the belief in prophetic dreams, in which facts are revealed which seem to the consciousness of the waking man to lie outside his knowledge. Thus Abercrombie for several days tried to recall a verse of the Bible he had learned as a child of seven; his efforts were unsuccessful, but one night in a dream he saw before him this verse and the chapter of Jeremiah in which it occurred. The same author mentions the case of a bank clerk who, in making up his accounts, found a deficit of £6. He sought in vain to remember what he had done with the money. At night, however, he saw in a dream a stammering man who begged him to give him this sum at once, and he handed it over immediately, in order not to keep him waiting. On awaking he reflected on the dream, and was able to prove its accuracy. Liébault records another dream of this class: a patient of his dreamed that she was in danger of drowning, and was saved by a man named Olry. Some years later a gentleman entered her house bearing a strong resemblance to him who had saved her in the dream. She was so struck by the resemblance that she at once asked: "Is your name Olry?" The unknown, who had only been seen in a dream, replied that it was. This dream, as Liébault remarks, might pass for a miracle; but on inquiry it was ascertained that this Olry lived only a

few miles from the lady, who could very easily have seen him; but she had forgotten this, as well as the name of her imaginary saviour. Another case is narrated by Maury: A certain M——, who had been educated at Montbrison and, twenty years previously, had lived there for some time, at last resolved to revisit the town. The night before leaving he dreamed that on arriving at Montbrison he met a gentleman who mentioned his name and said that he was an old friend of his father's. Next day he set out for the town, and on arriving saw the landscape of his dream, and was greeted by the gentleman of his dream, who announced himself as his father's friend; he was, however, much older than in the dream. In such a case it is clear that the emotion excited by the approaching departure had aroused slumbering recollections. Again, Macario tells us of a son who, having inherited a plot of land from his parents, was well able to recall having heard his father say that he had bought the land and paid for it, but he was unable anywhere to find the title-deeds, and ran the risk of losing an action that was brought against him. On the night before the case was to be definitely decided he had a dream in which he saw his father, who told him that the deeds were in the hands of a certain retired notary. On awaking he proceeded to the notary's, obtained the deeds, and gained his case.[1]

[1] It is scarcely necessary to add that such dreams are frequently considered supernatural. Thus Mr. Greenwood, in a charming but unscientific volume on *Imagination in Dreams* (p. 100), tells of what he calls a "dream of revelation"; in this case a lady dreamed that a side door with a skylight was revealed to her as the means whereby thieves entered the house. Although she and her family had lived in this house for many years, she declared that she had never seen or heard of that skylight and door before it was revealed in the dream. There

In the face of such facts it may seem natural to conclude that memory may be more active during sleep than in the waking state. Dreams are largely made up of the traces of sensations left upon the neuro-cerebral organism, and as so eminent an investigator as Helmholtz has pointed out (as well as Brentano), these traces may offer characters and details which are not perceived during actual observation of the real object. Thus when the accumulated traces of old experience are stirred up within us during sleep, it is possible that there should come to light many details which in the waking state we had forgotten or even never consciously knew.

This is not, however, a real heightening of memory. During sleep the voluntary concentration of attention is impossible. Thus the field of sleeping consciousness is invaded by a flood of images and associations which are artificially eliminated during the day by the application of limited and too assiduous attention. As a result of this greater liberty of psychic life during sleep we are able to recall many facts and details which wholly escape us when awake. The phenomenon depends, not on a greater activity of memory, but on altogether secondary conditions.

It is thus that most so-called "prophetic" dreams may be explained. There are others which require a somewhat different explanation. We may, for instance, dream that such and such a person has made a request of us which seems to be wholly

are two alternatives: either the existence of the door was mysteriously revealed in the dream; or the lady had seen the door and then forgotten its existence. Although Mr. Greenwood uncritically adopts the former alternative, any one who is acquainted with the frequency of such delusions of memory will know that the second alternative is infinitely more probable.

unexpected, but which subsequently is actually made. In such a case it is probable that we already possess the data which would make the request probable, but that we had not in waking consciousness fully realised them or put them together; it was left to the chance associations of dreaming life.

Thus in the psychic life of sleep we are brought into a vaguer and larger world than we are conscious of during waking life, the world of our once-forgotten past, and the world, it may be also, of the forgotten past of the race. It is in that perhaps that the charm of dreams largely lies. In the hereditary transmission of the characters of the physical and psychic organism—the continuity of the germ-plasm as Weismann calls it, or the ideoplasm as Nägeli terms it—nothing is lost. The forms which thought takes are organic and transmitted by heredity. Even characteristic gestures, special and peculiar traits, the characteristics of the handwriting, of thought itself, are transmitted from one generation to another. They are certainly transmitted unconsciously. But we may perhaps dare to glance into a dim future when consciousness will have so vastly developed that it may reach back to embrace all that our ancestors felt and lived and have handed on to us as an organic patrimony. The men of science of that day will be called upon to investigate, not only the continuity of the germ-plasm, but the great secret of the continuity of consciousness through innumerable generations which follow and replace one another to infinity, bound together by that indestructible consciousness.

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